

CONSERVE BY BICYCLE PROGRAM STUDY

PHASE I REPORT



June 2007



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CHAPTER 1 INTRODUCTION

Background

In 2005, the Florida Legislature created Section 335.07, F.S., Conserve by Bicycle Program, within the Florida Department of Transportation (FDOT). As stated in the Scope of Services:

The purposes of the Conserve by Bicycle Program are to:

- *Save energy by increasing the number of miles ridden on bicycles, thereby reducing the usage of petroleum-based fuels.*
- *Increase efficiency of cycling as a transportation mode by improving interconnectivity of roadways, transit and bicycle facilities.*
- *Reduce traffic congestion on existing roads.*
- *Provide recreational opportunities for Florida's residents and visitors.*
- *Provide healthy transportation and recreation alternatives to help reduce the trend toward obesity and reduce long-term health costs.*
- *Provide safe ways for children to travel from their homes to their schools by supporting the Safe Paths to Schools Program.*

Study Goals

As part of this program, FDOT authorized the Conserve by Bicycle Program Study. The goals of the Conserve by Bicycle Program Study are to determine:

- *Where energy conservation and savings can be realized when more and safer bicycle facilities, such as bicycle paths, bicycle lanes, and other safe locations for bicycle use, are created which reduce the use of motor vehicles in a given area.*
- *Where the use of education and marketing programs can help convert motor vehicle trips into bicycle trips.*
- *How, and under what circumstances, the construction of bicycling facilities can provide more opportunities for recreation and how exercise can lead to a reduction of health risks associated with a sedentary lifestyle.*
- *How the Safe Paths to Schools Program and other similar programs can reduce school-related commuter traffic, which will result in energy and roadway savings as well as improve the health of children throughout the state.*

- *How partnerships can be created among interested parties in the fields of transportation, law enforcement, education, public health, environmental restoration and conservation, parks & recreation, and energy conservation to achieve a better possibility of success for the program. The above stakeholder groups for instance, may be brought into new or existing groups such as the Bicycle and Pedestrian Advisory Committee operated by Florida Department of Transportation.¹*

FDOT awarded a contract to a consultant team, led by Sprinkle Consulting, Inc., to carry out the Program Study. The other members of the consultant team are Kittelson and Associates, Inc., Rails-to-Trails Conservancy, and the Center for Urban Transportation Research at the University of South Florida. The scope for this Phase I Study appears in Appendix A.

Overview of the Study Process

As specified in the Phase I scope, a Steering Committee was assembled, consisting of the State Pedestrian/Bicycle Coordinator, other FDOT staff, as well as representatives from the Department of Environmental Protection, the Department of Community Affairs, MPOs, and other agencies and organizations. The Steering Committee guided the consultant team in the development of the four study tracks – facilities, Safe Routes to School, education and marketing, and partnerships. The Steering Committee also assisted the consultant team with selecting measurable criteria to meet the Program’s primary objectives (energy savings, stimulation of recreation/exercise to improve public health) and creating research plans for each study track. Appendix B lists the Steering Committee members.

The consultant team uncovered a wealth of information about facilities and programs through a search of *Transportation Research Record*, the National Transportation Library, and other sources. Members of the Conserve by Bicycle Steering Committee identified additional references and sources for research and review. In addition, members of the Association of Pedestrian and Bicycle Professionals (APBP) were requested to submit any information they had about relevant studies and programs. Each study and program was assigned to one or more study tracks – facilities, Safe Routes to School, education and marketing, or partnerships. Each study and program was reviewed with respect to four criteria: mode shift, replaced activity, energy

¹ Florida DOT’s Bicycle and Pedestrian Advisory Committee no longer exists.

conservation, and recreation and exercise. For the review, each study and program was categorized as follows:

- A-List Contains measurable criteria and conducted in Florida
- B-List Contains measurable criteria but conducted outside Florida
- C-List No measurable criteria, but may contain valuable references, citations, or comparative case studies with measurable criteria
- D-List No measurable criteria

There was available data to evaluate the increases in cycling associated with providing improved facilities for bicyclists. FDOT District 7 has an ongoing study to calculate these increased levels of bicycling as a function of bicycle facility type and environmental setting. The researchers started with those facilities that were selected for the FDOT District 7 study and expanded that list of facilities to include several additional facilities that were recommended by the Steering Committee. Traffic data were collected for each corridor user and demographic data were collected for the areas surrounding each corridor. These data were used to develop methods of predicting the number of additional bicycling trips that would occur as a result of providing improved facilities for bicyclists. The researchers then estimated the energy conservation and health benefits of providing bicycling facilities.

The literature search found that only a few programs had sufficient data to be used as part of this study. Consequently, the Steering Committee and FDOT staff were asked for information about forthcoming programs in Florida that would give the data needed to make precise estimates of increased bicycling and the resulting energy conservation and health benefits. However, none of the Safe Routes to School, education and marketing, and partnership programs in Florida are scheduled to start within the time frame of Phase I of the *Conserve by Bicycle Program Study*. After expanding the search to other states, the consultant team found examples of programs that had sufficient data to be used in this Phase I report.

Organization of Phase I Report

The remainder of this chapter provides a brief discussion of some of the benefits of providing bicycle facilities, beyond those of fuel savings and health benefits, and presents a history of providing for bicyclists in Florida. While not quantified as part of this project, it is worth acknowledging that these ancillary benefits do occur.

The subsequent chapters of this Phase I report describe the findings for facilities, Safe Routes to School, education and marketing, and partnerships, with an emphasis on the energy savings and health benefits. This Phase I report concludes with recommendations for facilities, Safe Routes to School, encouragement, enforcement, and additional efforts and evaluations.

Other Benefits of Bicycle Facilities

While health benefits and fuel savings are the focus of this Conserve by Bicycle Program Study, there are other benefits of providing bicycle facilities that are not quantified herein. These include safety, mobility, increased roadway capacity, other roadway benefits, emissions reductions and quality of life. While difficult to quantify, these additional factors represent real benefits and should not be overlooked when considering the merits of providing facilities and programs to promote bicycling.

Safety

Bicycling is an inherently safe activity. While bicycling, like walking or motorcycling, is not without its risks, the risks are drastically reduced for those who follow the rules of the road and stay aware of surrounding conditions. By providing well-designed bicycle facilities, and through Safe Routes to School, education, encouragement, and enforcement programs, bicyclists' behaviors can be improved and crashes reduced.

Research suggests that properly-designed bicycle lanes can reduce crashes.² Bike lanes have been shown to reduce the incidence of wrong way riding (*i.e.*, riding against traffic) (a major contributing cause of bicycle/motor vehicle crashes), increase motorist and bicyclist predictability, reduce sidewalk riding, and guide cyclists to the proper position for riding through intersections. Bicycle lanes can also reduce motorist overtaking bicyclist crashes by offsetting bicyclists from motorists. An additional benefit of bike lanes is the visual delineation of the regular travel lane at night. This becomes very important when motorists drive at a speed such that they cannot stop in the distance the roadway is illuminated by their headlamps.

² See, for example, Smith, R.L. and T. Walsh. Safety Impacts of Bicycle Lanes. *Transportation Research Record 1168*. Transportation Research Board, Washington, DC, 1988, pp. 49-59.

Shared use paths in their own rights of way can eliminate all but intersection conflicts with motor vehicles. If grade separated roadway crossings are provided at busy roadways, the potential for a bicycle/motor vehicle crash is further reduced along these corridors.

Mobility

In the 2002 Bicycle and Pedestrian Crash Exposure Survey, 4.2% of the respondents reported their households owned no motor vehicles.³ For these individuals walking and bicycling are primary forms of transportation. Many individuals cannot drive: those too young to have a drivers license, those with mental or physical impairments that make obtaining a license impossible, and those who have had their licenses revoked for some reason. For these individuals bicycling facilities can provide safe, convenient, and comfortable access to jobs, schools, parks, shops, and services they would not otherwise be able to access.

Roadway Capacity

The trip carrying capacity of roadways can be increased by promoting bicycling and providing bicycle facilities. A mode shift, as described in Chapter 2 on “Provision of Bicycle Facilities” (Mode Shift sub-section), may not necessarily result in fewer motorists on the roadway, however it will result in more trips being served. By including bicycle lanes or paths along a roadway, the carrying capacity of the roadway is increased – more people can use the roadway to access more destinations.

Providing the separated space for bicyclists benefits motorists by reducing their delay while traveling along the roadway. When bicyclists are sharing the motor vehicle travel lane under congested conditions, motorists frequently have to slow and wait for an opportunity to safely pass the cyclists.

³ CUTR. *Bicycle and Pedestrian Travel: Exploration of Collision Exposure in Florida*. University of South Florida, Tampa, FL, 2002.

Other Roadway Benefits

In addition to providing additional capacity for trips along a roadway, the provision of bicycle lanes and paved shoulders has other benefits. They increase the effective radii for turning trucks and buses, making it easier for them to turn on the available pavement and reducing maintenance costs. By offsetting the main travel lane(s) from the edge of the road, bike lanes/shoulders increase sight distance for vehicles turning onto the roads with them. They help provide temporary storage for disabled vehicles. They improve drainage of the main travel lanes. Shoulders also reduce the incidence of motorist run off the road crashes in rural areas.⁴

Emissions Reductions

By enabling people to travel by bicycle as opposed to an automobile, pollutant emissions can be reduced. The U.S. Environmental Protection Agency (EPA) estimates that 19.4 pounds of carbon dioxide (CO₂) are produced for each gallon of gasoline used in an automobile.⁵ Additionally, automobiles produce methane (CH₄) and nitrous oxide (N₂O). Hydrofluorocarbons can also leak from automobile air conditioners. The EPA estimates that CH₄, N₂O, and HFCs account for an additional 5 percent of emissions from autos. Actual reductions due to bicycling are probably greater than this estimate as automobile emissions are greater on short trips from cold starts than on longer trips; bicycling would likely replace more of these short trips. Bicycling, while not emissions free (production of the bike, tires, riding clothes, and other cycling equipment results in emissions), is much less polluting than driving a car. It should also be remembered that any emission reduction benefits from bicycling only occur if the cycling trip replaces a motor vehicle trip.

Quality of Life

Many communities in Florida have recognized that providing bicycling (and walking) opportunities improves the quality of life of their residents. This recognition can be found in

⁴ Zegeer, C.V., D.W. Reinfurt, J. Hummer, L. Herf, and W. Hunter. Safety Effects of Cross-Section for Two-Lane Roads. *Transportation Research Record 1195*. Transportation Research Board, Washington, DC, 1988, pp. 20-32.

⁵ US EPA website, <http://www.epa.gov/otaq/climate/420f05004.htm#step4>, Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle.

their comprehensive plans, long range transportation plans, bicycle, pedestrian, and greenways plans, local ordinances, and zoning codes. Additionally, home buyers find the provision of sidewalks, paths, and bicycle lanes desirable; consequently many new developments in Florida are including networks of bicycle facilities throughout their properties.

The provision of shared use paths is frequently accomplished coincident with preservation of green space. Shared use paths are often created as linear parks with landscaping, and frequently with links to additional recreational opportunities. This further enhances the quality of life for Florida's residents.

Existing Conditions and Trends

History of Providing for Bicyclists in Florida

Florida has been providing on-road bicycle facilities and paths for bicyclists' use for more than twenty-five years. FDOT has implemented design standards, performed research, and continued to revise its criteria as needed to keep its standards among the most progressive in the United States.

With its policy of routine accommodation (include bike facilities whenever roadways or intersections are being constructed, reconstructed, or resurfaced) the Department has been consistently improving the bicycle facilities network throughout Florida. A recently completed inventory of bicycle facilities on the State Highway System (SHS) in Florida stated that

Of the 10,454 miles studied, the state currently has 6,538 miles of on-road bikeways, which represents 63 percent of the SHS. In this Executive Summary and in the supporting data and analysis of this study, recommendations are provided to address the remaining 37 percent of the SHS roadways that currently do not have on-road bikeways.⁶

A brief review of FDOT's bicycling-related standards is presented in the following paragraphs.

The FDOT *Plans Preparation Manual* (PPM) is the standards document for the Department. It sets forth geometric and other design criteria, as well as procedures for FDOT projects. The 1981 FDOT *Plans Preparation Manual* cited AASHTO's *A Guide for Bicycle*

⁶ FDOT. *Statewide Bicycle Facilities Study, Executive Summary*. Florida Department of Transportation. Tallahassee, FL, 2006.

*Routes*⁷ as a reference for design criteria. In 1982 FDOT adopted its own *Bicycle Facilities Planning and Design Manual*; the criteria therein were included by reference into the 1985 update to the FDOT *PPM*. In the 1989 revision, FDOT began to include more specific design criteria into the *PPM* rather than just reference source documents. With regard to bicycle facilities, the 1989 *PPM* created a requirement to provide bicycle facilities by stating the following:

“Wide curb lanes are to be provided as the minimum treatment in conjunction with other roadway improvements (curb and gutter construction) in or within one mile of all urbanized (population greater than 50,000 or more) areas unless right of way is inadequate and cost associated with acquisition for this purpose is not feasible.”

The 1989 *PPM* also included bike lanes as an optional treatment and included text allowing for the narrowing of general travel lanes and turn lanes to allow the cross section space to provide for bike lanes or wide curb lanes. This *PPM* also included the requirement to provide 4 foot wide paved shoulders on all non-curb and gutter roadways.

The 1989 *PPM* included a separate chapter on bicycle and pedestrian facilities design. This chapter outlined the benefits of providing bike lanes and included text from and references to the 1981 AASHTO *Guide for the Development of New Bicycle Facilities*.⁸

FDOT’s bicycle treatments have kept pace with the state of the art/knowledge. In the years prior to 1989, and into the early 1990s, the bicycling community endorsed the wide curb lane as the preferred treatment for bicyclists. Many advocates questioned the safety of bike lanes and believed that wide lanes provided the safest facility for bicyclists. Over the next several years, FDOT (and other agencies) performed research on the benefits of bike lanes versus wide curb lanes. Bicycling advocates and transportation professionals came to realize that although wide curb lanes might be satisfactory for experienced adult cyclists, most people would not chose to ride in a shared lane, arterial roadway environment. This realization and the data from several research projects convinced FDOT to change its standard bicycle facility: the 1995 *PPM*

⁷ AASHTO. *Guide for Bicycle Routes*. American Association of State Highway and Transportation Officials, Washington, DC, 1974.

⁸ AASHTO. *Guide for the Development of New Bicycle Facilities*. American Association of State Highway and Transportation Officials, Washington, DC, 1981.

changed from the provision of wide curb lanes to the provision of bike lanes as the standard for state roadways in urban areas.

The 1998 FDOT *Project Development and Environment Manual* also includes the requirement to provide bike lanes for all new and reconstructed roadways. FDOT's *Design Standards*⁹ was revised to include examples of how to stripe bike lanes through intersections. Since 1995, several research projects have substantiated bike lanes as safe facilities for cyclists who ride as prescribed by the traffic laws.

In addition to providing design criteria for bike facilities, and guiding their inclusion on projects, FDOT has developed tools for local governments to use in planning and evaluating their transportation networks for bicyclists. In response to the legislature's directive (Section 163.3180(15)(a), F.S.), FDOT evaluated and adopted a precise and accurate method for measuring the quality of the on-road bicycling environment. This method is based upon research which used real cyclists rating real roadways in real traffic. It (and FDOT's pedestrian methodology) has become the model for the national trends in measuring the quality of bicycle facilities. FDOT's *2002 Quality/Level of Service Handbook* is the first of its kind to provide methods for measuring the quality of bicycle (and pedestrian facilities). FDOT's *Greenbook* provides guidance for bicycle facilities but does not require the provision of bicycle facilities.

Throughout the development and evolution of the bicycle facilities standards, there has been recognition that some people, especially children, lack the skills needed to ride safely on busy roadways. However, there is a substantial body of research that suggests pathways adjacent to roadways are less safe than either shared lanes or bike lanes.^{10 11 12} These facts created a dilemma: how to provide for mobility while maintaining safety. Correspondingly, FDOT's District One commissioned a study to determine if shared use paths adjacent to roadways could

⁹ FDOT. *Design Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System*. Florida Department of Transportation, Tallahassee, FL, 2002.

¹⁰ Moritz, W. Adult Bicyclists in the United States - Characteristics and Riding Experience in 1996. *Transportation Research Record 1636*, TRB, National Research Council, Washington, DC, 1998.

¹¹ Wachtel, A. and D. Lewiston. Risk Factors for Bicycle-Motor Vehicle Collisions at Intersections. *ITE Journal*, September, 1994.

¹² Räsänen, M. How to decrease the number of bicycle accidents? A research based on accidents studied by road accident investigation teams and planning guides of four cities. Finnish Motor Insurer's Centre, Traffic Safety Committee of Insurance Companies. VALT. Helsinki, Finland, 1995.

be built that would not degrade the safety of the bicycling network and what geometric and operational factors influence the safety of the pathways adjacent to the roadway. This study was completed in 2005 and found that there **are** ways to design safe shared use paths adjacent to roadways under some conditions.¹³ This study also developed an outline of how the Level of Service for these facilities could be measured.

Florida continues to lead the nation in bicycle safety and mobility research. From updating their roadway level of service models to testing new and innovative design treatments, FDOT continues to show its commitment to improving the transportation network for non-motorized users.

Statewide Estimates of Energy Savings

As additional background for this report, the consultants researched studies that could be used to estimate how much cycling occurs in Florida. Two surveys performed by FDOT, the first in 1998 and the second in 2002, allowed the consultants to make some general estimates of the magnitude of cycling activities in Florida.^{14, 15} From the data in these studies, the amount of energy saved by Florida's bicyclists can be estimated. These FDOT studies employed phone surveys to determine how often individuals rode bikes (or walked) and their crash experiences. Floridians from four of Florida's urbanized areas were surveyed: Jacksonville, Miami, Orlando and Tampa. For the *Conserve by Bicycle Program Study*, the section below makes use of the bike trip data to identify some trends in Florida.

In both the 1998 and 2002 surveys, about three-fifths of the respondents were female. Respondents in 1998 were 16 years of age and older; respondents in 2002 were 18 years of age and older. A review of the survey data reveals an increase in bicycling between 1998 and 2002. In 1998 the average bicycling trip rate reported was 0.12 bicycling trips per day. This increased

¹³ Landis, Bruce, *et al.* Sidepath Facility Selection and Design. Prepared for Florida Department of Transportation. May 2005. Available online at http://www.dot.state.fl.us/safety/ped_bike/brochures/pdf/Sidepath%20facility%20selection%20&%20design.pdf

¹⁴ NuStats International, *Bicycle and Pedestrian Travel: Exploration of Collision Exposure in Florida*, Austin, TX, December 1998.

¹⁵ CUTR. *Bicycle and Pedestrian Travel: Exploration of Collision Exposure in Florida*. University of South Florida, Tampa, FL, 2002.

to 0.17 trips per day in the 2002 survey. The length of the average bicycling trip length decreased from an average of 5.14 miles per trip in 1998 to 4.53 miles per trip in 2002.

Extrapolating the data from the two surveys and applying them to the overall population of Florida that lives in Metropolitan Statistical Areas (MSA's) (about 88% and 94% of the population of Florida in 1998 and 2002 respectively), it is possible to obtain some idea of the magnitude of the benefits of bicycling in Florida. Using just the reported trip rates and distances, the number of annual trips and miles bicycled in Florida MSAs¹⁶ can be estimated (Table 1-1):

Table 1-1 Estimated Levels of Bicycling in Florida MSAs

Year	Annual Trips	Annual Miles
1998	611 Million	3.1 Billion
2002	961 Million	4.4 Billion

Based upon the above numbers, fuel savings can be calculated by determining the number of utilitarian bicycling trips replacing utilitarian car trips. These trips (those made by bicycling instead of driving) represent about 25% of the overall bicycling trips reported in the 2002 survey (1998 values were not reported in the final project report). Using the reported bicycling trip rates, the average trip length and the percent utilitarian trips, the number of miles bicycled for utilitarian purposes can be calculated. By using an average gas mileage of 20 mpg and cost for fuel of \$1.20/gallon and \$1.40/gallon for 1998 and 2002, respectively, these values yield energy savings of \$59.4 million and \$76.2 million, respectively, in 1998 and 2002.

Chapter 2 of this Phase I report describes the energy savings and health benefits that can be expected as a result of providing bicycle facilities.

¹⁶ As defined by the Census Bureau in 2003, Florida's MSAs are: Cape Coral – Fort Myers, Deltona – Daytona Beach – Ormond Beach, Fort Walton Beach – Crestview – Destin, Gainesville, Jacksonville, Lakeland – Winter Haven, Miami – Fort Lauderdale – Miami Beach (includes West Palm Beach), Naples – Marco Island, Ocala, Orlando, Palm Bay – Melbourne – Titusville, Pensacola – Ferry Pass – Brent, Port St. Lucie – Fort Pierce, Punta Gorda, Sarasota – Bradenton – Venice, Tallahassee, Tampa – St. Petersburg – Clearwater, and Vero Beach. More information is available online at <http://www.census.gov/population/www/estimates/metroarea.html>.

CHAPTER 2 PROVISION OF BICYCLE FACILITIES

The following sections describe how the Conserve by Bicycle Phase I Study evaluated how the provision of various types of bicycle facilities, in various built environments, can influence the number of people who choose to ride bicycles and the corresponding energy conservation and health benefits. To evaluate these influences, a method to predict the number of new bicycle trips resulting from the provision of facilities was developed. Methods for quantifying the impacts of predicted increases in bicycling were then identified. The assumptions made with regard to trip making frequency of individual users are discussed below. To obtain the specific benefits associated with providing specific facility types in varying built environments, spreadsheets to perform “what if” type analyses were developed.

Many Floridians report that they would ride bikes more often if safe bicycling facilities were provided.¹⁷ This suggests that the safer a facility is perceived by the bicyclist, the more likely it is to be used. The most common type of bicycle facility is a shared roadway (also known as a shared use lane), in which bicyclists share a travel lane with motorists (Figure 2-1). The American Association of State Highway and Transportation Officials (AASHTO) defines a shared roadway as “A roadway which is open to both bicycle and motor vehicle travel. This may be an existing roadway, street with wide curb lanes, or road with paved shoulders.”¹⁸



Figure 2-1 Shared use lane

Other types of bicycle facilities include wide curb lanes, bicycle lanes/paved shoulders, shared use paths adjacent to roadways, and independent alignments (also known as rail-trails or shared use paths). AASHTO defines a bicycle lane as “A portion of a roadway which has been designated by striping, signing

¹⁷ Berman, Evan. *FDOT Bicycling and Walking Attitudes Survey, District 5*, UCF, Orlando FL, August 2003.

¹⁸ AASHTO. *Guide for the Development of Bicycle Facilities*. American Association of State Highway and Transportation Officials, Washington, DC, 1999.



Figure 2-2 Bicycle lane

and pavement markings for the preferential or exclusive use of bicyclists.”¹⁹ Figure 2-2 depicts a bicycle lane, and Figure 2-3, a paved shoulder.

In addition, AASHTO defines a shared use path as “A bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users.”²⁰ For the purposes of this Phase I report, an independent alignment is a shared use path that is within an independent right-of-way (Figure 2-4). Other shared use paths are adjacent to the roadway, within the highway right-of-way (Figure 2-5).



Figure 2-3 Paved shoulder

The different facility types provide varying degrees of comfort and perceived safety to different types of bicyclists. Each type requires different levels of consideration in design and construction. The FDOT *Bicycle Facilities Planning and Design Handbook*²¹ and the AASHTO *Guide for the Development of Bicycle Facilities*²² contain more information about different bicycle facility types.

¹⁹ AASHTO. *Guide for the Development of Bicycle Facilities*. American Association of State Highway and Transportation Officials, Washington, DC, 1999.

²⁰ AASHTO. *Guide for the Development of Bicycle Facilities*. American Association of State Highway and Transportation Officials, Washington, DC, 1999.

²¹ FDOT. *Florida Bicycle Facilities Planning and Design Handbook*. Florida Department of Transportation, Tallahassee, FL, 1999.

²² AASHTO. *Guide for the Development of Bicycle Facilities*. American Association of State Highway and Transportation Officials, Washington, DC, 1999.

The aforementioned FDOT *Quality/Level of Service Handbook* provides an accurate method reflecting how Floridians perceive the safety of the on-road bicycle facilities (i.e., standard travel lane, wide curb lane, paved shoulders or bike lanes).



Figure 2-4 Independent alignment



Figure 2-5 Shared use path adjacent to roadway

Energy Conservation and Savings

One of the stated purposes of the Conserve by Bicycle Program is to:

- *Save energy by increasing the number of miles ridden on bicycles, thereby reducing the usage of petroleum-based fuels.*

This purpose is echoed in the study goal of determining:

- *Where energy conservation and savings can be realized when more and safer bicycle facilities, such as bicycle paths, bicycle lanes, and other safe locations for bicycle use, are created which reduce the use of motor vehicles in a given area.*

In 2006, Floridians consumed about 8.6 billion gallons of gasoline, or about 470 gallons per person.²³ At \$3.00 per gallon, this translates to \$25.8 billion for all Floridians, or \$1,410 per person in 2006. As a result of rapidly rising fuel prices, Floridians are now spending more on gasoline than ever before. Individuals can reduce their energy consumption and transportation-related expenditures by driving less; provision of bicycle facilities perceived to be safe is one way the State of Florida can accomplish this.

²³ Seidel, Valerie and Mark Schneider. *2006 Florida Motor Gasoline and Diesel Fuel Report*. Florida Department of Environmental Protection, Tallahassee, FL, 2007.

Literature Search

Task 2 of the Scope of Services states that:

- *The Consultant will complete a literature search which will highlight case studies of successful programs which have achieved some or all of the [Conserve by Bicycle Program Study] goals. Research will include an evaluation of existing Florida-based programs that relate to the study goals, out-of-state statewide research, and national studies/programs. These case studies will be evaluated to determine which components would be most applicable in Florida.*

As part of the literature search, the researchers reviewed numerous studies of the impacts of bicycle facilities on the rates of bicycling. A few studies included counts of bicyclists on facilities. However, nothing was available to allow the consultant team to predict how many bicyclists are likely to use a bicycle facility improvement, nor what the energy conservation and health benefits would result. Therefore, methods for predicting the number of bicyclists and the accompanying energy conservation and health benefits were developed as part of this project.

The complete literature search pertaining to energy conservation and savings appears in Appendix Q of this Conserve by Bicycle Study Phase 1 Report.

Measurable Criteria

According to the Scope of Services, the Conserve by Bicycle Program Study:

- *Shall produce measurable criteria that can be used by [FDOT] to determine where and under what circumstances the construction of bicycling facilities will reduce energy consumption and the need for and cost of roadway capacity, as well as realizing the associated health benefits.*

To measure the energy conservation of providing bicycle facilities, the number of people who will use bicycle facilities if they are provided, must be known. Thus, measurable criteria for evaluating the energy conservation and savings resulting from the provision of bicycle facilities are *mode shift* and *replaced activity*. These are discussed in the following paragraphs.

Mode Shift

A mode shift occurs when an individual changes his/her mode of travel, for example, from car to bicycle, car to walk, or car to transit. The provision of a bicycle facility results in energy savings if the provision of that facility results in an individual who would otherwise have driven a car choosing to ride a bicycle.

Replaced Activity

The presence of a bicycle facility may motivate some individuals to opt for bicycling on the facility instead of pursuing another activity. Individuals can choose from among many options for leisure. These include riding a bicycle on a trail, driving to the park, staying at home and watching rented movies, to name just a few. Replacing an activity with bicycling may or may not result in energy savings. If a person rides a bicycle from his/her home to a trail and then back home, instead of driving to the park, then energy savings will result because the bicycle trip replaces the driving trip. On the other hand, if a person drives to a trail head, rides a bicycle on a trail, and then drives back home, then energy savings may or may not result. Indeed, if the alternate choice was to stay at home and watch movies, then the trail has created a new driving trip.

The literature search described above found no information related to replaced activity. While the impact on energy savings is likely minimal, a specific study would be needed to confirm this.

Research Plan

To address the Study goals, the extent of mode shift that results from the construction of bicycle facilities needs to be determined. That is, how many users will be mode-shifted from the motor vehicle mode to the bicycle mode? After determining the number of users that will be using the facility, the energy savings for that facility can be calculated.

To answer this question, the research plan included a study evaluating different bicycle facility types in different built environments to determine the mode shift resulting from those facilities. Based upon data collected on these facilities, the researchers developed a method for predicting the mode shift resulting from the provision of these facilities. The researchers also identified values associated with energy savings resulting from a mode shift to bicycling. Using

these values, the energy savings resulting from providing specific bicycle facilities could be predicted.

Mode Shift The first step was to determine which factors were important for predicting the mode shift. Only after doing this could the necessary data needs be determined.

When planning a utilitarian trip (for example, to work, to school, to a doctor's appointment, etc.), people have a choice among modes (such as car, transit, bicycle, walk). Each mode has a "utility," defined as a level of attractiveness or satisfaction, associated with it. Infrastructure investments or changes in operational and demographic characteristics may increase the utility of one mode relative to the others, or in other words, make one mode more attractive relative to the others. For example, the construction of a bicycle lane on a roadway that currently has a shared use lane would make the bicycle mode more attractive because individuals would perceive the bicycle lane as being more accommodating of bicycling. As another example, the bicycle mode is more attractive for a shorter trip (*e.g.*, 5 miles) than it is for a longer trip (*e.g.*, 20 miles). As the attractiveness (*i.e.*, utility) of bicycling increases, more individuals are expected to choose the bicycle mode.

To identify the specific factors that should be evaluated, the researchers consulted several groups: members of the Steering Committee, participants in the national ProWalk/ProBike Conference, and a variety of other transportation professionals and bicyclists from around the United States. They identified that the following characteristics of bicycle facilities influence their decisions to make utilitarian bicycle trips:

- Congestion on the roadway
- Quality of the bicycle facility
- Transit quality of service
- Bicycle network friendliness
- Pedestrian network friendliness
- Trip length
- Population * employment density

These characteristics are described in the following sections:²⁴

Congestion on the Roadway The presence of motor vehicles can make bicyclists uncomfortable and therefore can adversely impact their propensity for making bicycle trips. Motor vehicle congestion on the roadway ranges from minimal congestion to gridlock. The Florida DOT has pioneered the development, adoption, and refinement of quality of service measures (*Quality/Level of Service Handbook 2002*, FDOT), including motor vehicle level of service (LOS), which measures this motor vehicle congestion on the roadway. This level of service quantifies the congestion experienced by motorists on the roadway and was chosen to represent congestion in this mode shift methodology.

Motor vehicle LOS ranges from A (least congested, free flow) to F (most congested, forced or breakdown flow). An improvement in the motor vehicle LOS (*e.g.*, from D to C) is expected to increase the utility of driving, since the roadway has become less congested and the motorist can travel at higher speeds. Conversely, the utility of driving decreases when the motor vehicle LOS worsens (*e.g.*, from D to E) because motorists may become frustrated by being “forced” to travel at slower speeds and may perceive driving as more of an “ordeal.”

Buses generally share the roadway with cars and trucks. Therefore, when motorists encounter delays, so do bus riders. An improvement in the motor vehicle LOS is expected to increase the utility of riding the bus. Utility increases less for bus riders than for motorists because many bus riders are “captive” riders who are riding because they do not have a car available for the trip.

Figure 2-6 shows the expected relationships between motor vehicle LOS and utilities for motorists (U_{MV}) and bus transit riders (U_T).

²⁴ Much of the following section is adapted from the FDOT District 7 report, *Predicting Non-motorized Trips at the Corridor/Facility Level: The Bicycle & Pedestrian Mode Shift and Induced Travel Models*, February 2007.

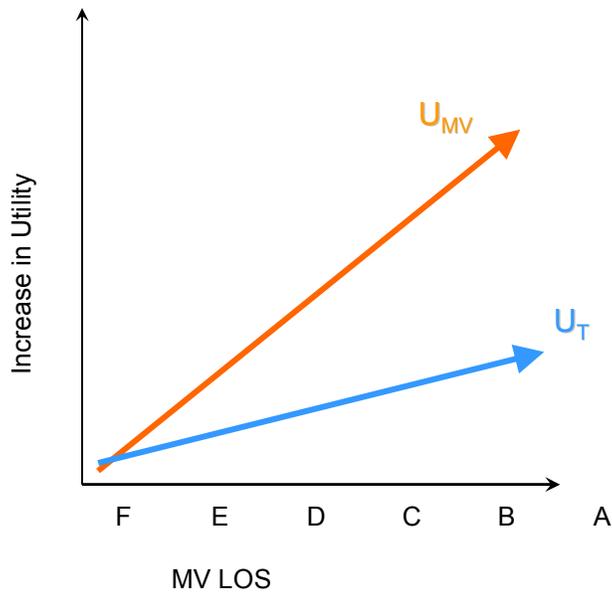


Figure 2-6 Utility by motor vehicle LOS

Quality of Bicycle Facility Improvements in bicycling conditions, such as adding bicycle lanes, increase the quality of the level of accommodation for bicyclists. Not surprisingly, improvements in bicycling conditions and level of accommodation will increase the utility of bicycling, since bicyclists will likely feel safer and more comfortable while riding. Improvements may also slightly increase the utility of transit in that some individuals will be more likely to ride bicycles to/from transit.

FDOT has also developed a methodology for quantifying how safe and comfortable bicyclists feel while riding on a facility. This methodology is known as the bicycle level of service (LOS). Level of service “A” represents low-volume, low-speed streets with few heavy vehicles where nearly everyone would feel comfortable riding. Level of service “F” represents high-volume, high-speed streets with many heavy vehicles where very few would feel comfortable riding.

Figure 2-7 shows the expected relationships between bicycling conditions/level of accommodation and utilities for bicyclists (U_B) and transit riders (U_T).

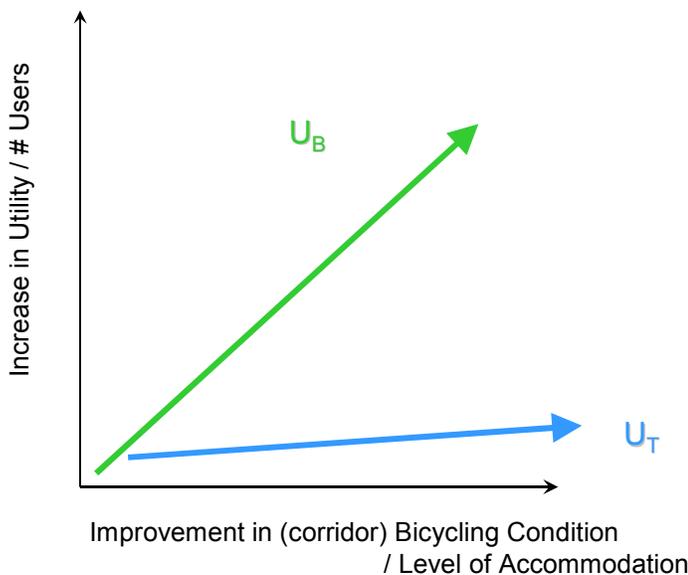


Figure 2-7 Utility by bicycle LOS

Quality of Pedestrian Facility Improvements in walking conditions, such as adding sidewalks, increase the quality of the level of accommodation for pedestrians. Not surprisingly, improvements in walking conditions and level of accommodation will increase the utility of walking, since pedestrians will likely feel safer and more comfortable while walking. Improvements may also slightly increase the utility of transit in that some individuals will be more likely to walk to/from transit.

FDOT has also developed a methodology for quantifying how safe and comfortable pedestrians feel while walking on a facility. This methodology is known as the pedestrian level of service (LOS). Level of service “A” represents low-volume, low-speed streets with wide separation between pedestrians and motor vehicles where nearly everyone would feel comfortable walking. Level of service “F” represents high-volume, high-speed streets with little separation between pedestrians and motor vehicles where very few would feel comfortable walking.

Figure 2-8 shows the expected relationships between pedestrian conditions/level of accommodation and utilities for pedestrians (U_P) and transit riders (U_T).

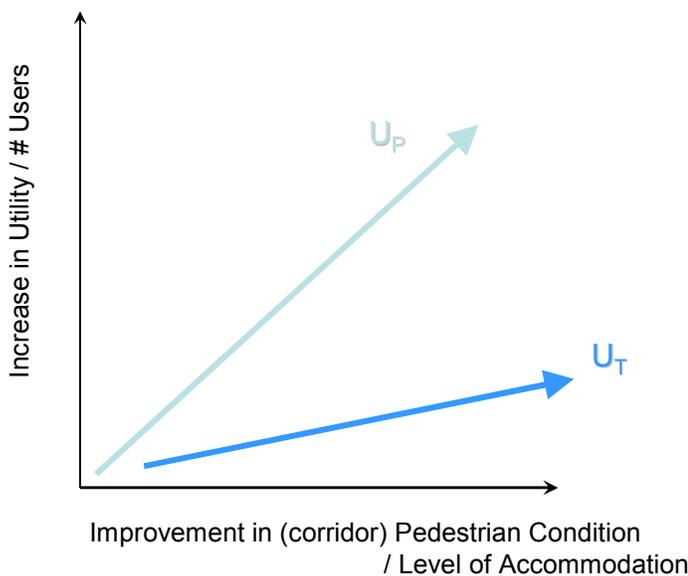


Figure 2-8 Utility by pedestrian LOS

Transit Quality of Service Numerous bicycle trips are for the purpose of accessing transit; essentially using their bicycles to access a destination (transit stop) that allows them to access still more destinations. In this way the provision of transit extends the range of the bicycle trip increasing its utility.

Transit quality of service measures how good people feel the transit service is. It is on the same scale as motor vehicle LOS, bicycle LOS, and pedestrian LOS (“A” is the best and “F” is the worst). Improvements in transit quality of service (such as more frequent buses/shorter headways) make transit a more attractive mode choice and therefore increase the utility of transit. The utilities of walking and bicycling are expected to increase as well, though to a lesser extent than the utility of transit, since walking and bicycling provide access to and from transit.

Figure 2-9 shows the expected relationships between transit quality of service and utilities for transit riders (U_T), pedestrians (U_P), and bicyclists (U_B).

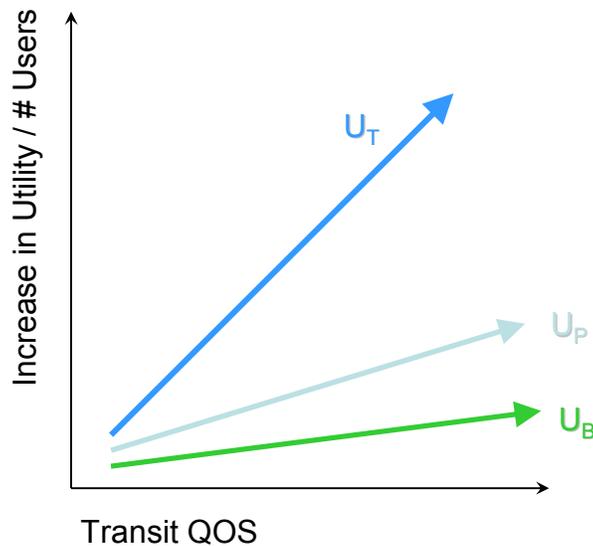


Figure 2-9 Utility by transit quality of service

Network Friendliness Network friendliness is a measure of how “friendly” the surrounding roadway network is to bicycling. This measure recognizes that while a specific corridor may accommodate bicyclists, if the surrounding roadways are not bicycle-friendly, then few bicyclists are likely to ride along that corridor, simply because getting to the corridor is perceived to be unsafe. Conversely, if the surrounding roadways are accommodating, then more bicyclists are likely to ride along that corridor, because getting to the corridor is perceived to be safe and comfortable. Appendix G of this Phase I Report contains a more detailed description of network friendliness.

Figure 2-10 shows the expected relationships between network friendliness and utilities for bicyclists (U_B) and transit riders (U_T).

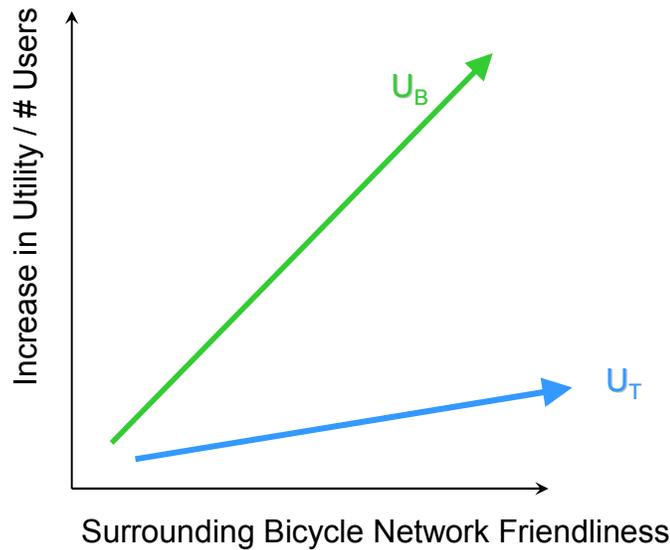


Figure 2-10 Utility by network friendliness

Trip Length Trip length has a significant impact on people’s decision to use bicycles for utilitarian trips. In part this may be due to the increase in travel time associated with bicycling as opposed to driving.

Figure 2-11 shows the expected relationships between trip length and utilities for motorists (U_{MV}), transit riders (U_T), bicyclists (U_B), and pedestrians (U_P). For shorter trips, walking is a viable mode choice for many individuals. Thus, the utility for pedestrians starts off high and decreases rapidly with increasing trip lengths. The utility for bicyclists is low for very short trips (as walking is often more convenient), increases as trip length increases, and then decreases rapidly (as travel time may be perceived as becoming excessively long). The utility for transit riders is low for short trips (as walking and bicycling are often more convenient), increases as trip length increases, and then decreases for very long trips (as travel time may be perceived as becoming excessively long or transfers become more likely). As trip length increases, the utility of the motor vehicle mode increases relative to the other modes.

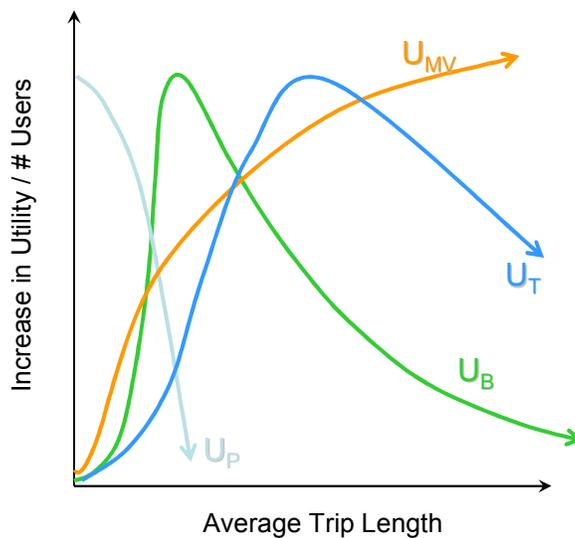


Figure 2-11 Utility by trip length

Income The bicycle has a high utility for utilitarian trips for those with low income. As income increases, the utility of bicycling initially decreases. However as income continues to rise, the utility of the bicycle once again increases. This reflects a greater awareness of fitness, a greater propensity for recreational exercise, and a greater willingness to invest in the cost for road cycling associated with higher incomes.

The utility of driving increases with higher average income, as individuals with higher incomes are more likely to own a car and to place a higher value on their time. Conversely, the utilities of walking and transit decrease with higher income.

Figure 2-12 shows the expected relationships between income and utilities for motorists (U_{MV}), transit riders (U_T), bicyclists (U_B), and pedestrians (U_P).

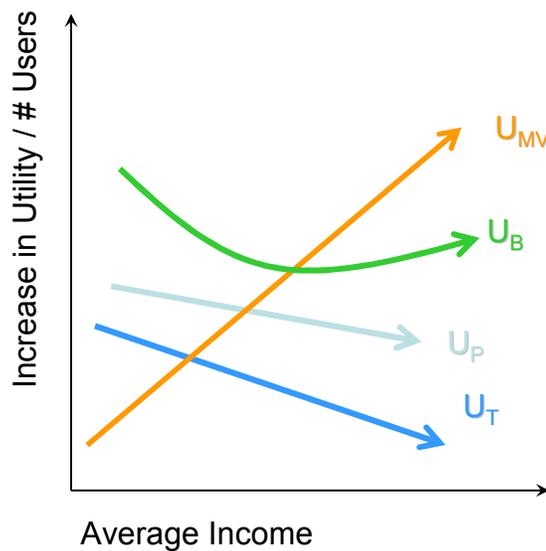


Figure 2-12 Utility by income

Population and Employment Density The higher the density of mixed land uses, the more opportunities there are for short trips and consequently the utility using the bicycle is increased. By definition, utilitarian trips have a purpose, such as work, school, or shopping. That is, these trips have origins and destinations. Population density and employment density are measures of how many origins and destinations are present in a specified area. Taking the product of population and employment, then dividing by the area, accounts for the combined effects of both on utility. When population and employment densities are high, the utilities of walking, bicycling, and transit are higher than when densities are low. In turn, higher utilities of walking, bicycling, and transit translate into a lower relative utility for driving.

Figure 2-13 shows the expected relationships between population multiplied by employment, then divided by area (population*employment density) and utilities for motorists (U_{MV}), transit riders (U_T), bicyclists (U_B), and pedestrians (U_P).

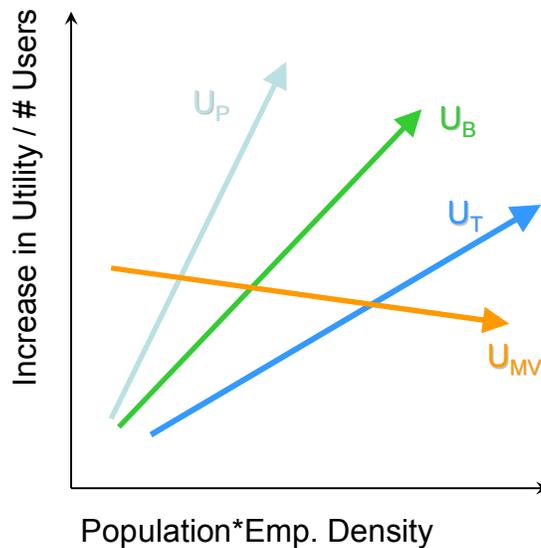


Figure 2-13 Utility by population * employment density

Bicycle-Friendly Community The utilities associated with bicycling and walking are thought to be higher when a community is bicycle-friendly, that is, the community has policies to provide for and encourage bicycling. This is a difficult community characteristic to quantify. However, the League of American Bicyclists has a program to recognize bicycle-friendly communities. There are several levels of recognition based upon measures taken by the community to promote bicycling. The highest designation is Platinum (currently held by only one city: Davis, CA), followed by Gold, Silver, Bronze, and Honorable Mention. Among cities in Florida, Gainesville has a Silver designation, while Boca Raton, Orlando, and St. Petersburg have Bronze designations.

Figure 2-14 shows the expected relationships between bicycle-friendly community designations and utilities for motorists (U_{MV}), transit riders (U_T), bicyclists (U_B), and pedestrians (U_P).

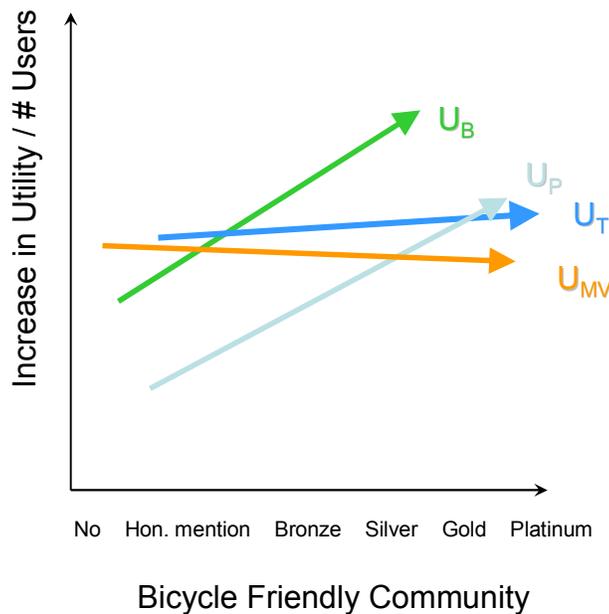


Figure 2-14 Utility by bicycle-friendly community

Data Collection

To determine how each of the factors might impact mode shift to bicycling, seventeen corridors with varying types of bicycle facilities were identified for study (Table 2-1). The corridors were

nominated by FDOT staff and by members of the Steering Committee. Some corridors were chosen because they currently have bicycle facilities (bike lane, sidepath, or shared use path). These were used as surrogate “after” data points. Other corridors were chosen because they are scheduled to receive a facility in the near future. These were used as “before” data points, in this first phase; they will also be used as some of the “after” data points in Phase II of this study.

Table 2-1 Study Corridors

ID	Name	From	To	Location	Facility Type	Sidewalks	Length of Facility (mi)	Width of Facility (ft)
1	16 th St S	Pinellas Point Dr	62 nd Ave S	St. Petersburg	Bike lane (E) ¹	One side	1.71	4
2	31 st St N	Central Ave	5 th Ave N	St. Petersburg	Bike lane (P) ¹	Both sides	5.19	4
3	Bruce B. Downs Blvd	Amberly Dr	Hunter's Green Dr	Tampa	Shared use path adjacent to roadway (P)	One side	4.3	10
4	Bruce B. Downs Blvd	Hillsborough County line	SR 54	Wesley Chapel	Shared use path adjacent to roadway (P)	None	6.88	10
5	CR 550	Shoal Line Blvd	US 19	Weeki Wachee	Paved shoulders (P)	None	3.4	5
6	Elgin Blvd	Deltona Blvd	Mariner Blvd	Spring Hill	Paved shoulders (P)	None	5.4	5
7	Lutz-Lake Fern Rd	Gunn Hwy	Dale Mabry Hwy	Lutz	Shared use path adjacent to roadway (P)	None	6.9	Unknown
8	US 41	Kennedy Blvd	Bearss Ave	Tampa	Bike lane (P)	Both sides	9.4	4
9	SR 60	Kings Ave	Kingsway Rd	Brandon	Bike lane (P)	Both sides	21.5	5

ID	Name	From	To	Location	Facility Type	Sidewalks	Length of Facility (mi)	Width of Facility (ft)
10	U.S. Alt. 19 (Pinellas Trail)	Union St	Orange St	Dunedin	Independent alignment (E)	Both sides	34	10
11	20 th St	Adamo Dr	Causeway Blvd	Tampa	Shared use path adjacent to roadway (E) ¹	None	1.86	12
12	US Route 1 (M Path)	SW 67 th Ave	SW 7 th St	Miami, Coral Gables	Shared use path adjacent to roadway (E)	One side	8.226	8
13	Sunrise Blvd	Hiatus Rd	Pine Island Rd	Plantation	Bike lane (P) ¹	Both sides	1.8	5
14	Spring to Spring Trail	Gemini Springs Park	DeBary Hall	Volusia County	Independent alignment (E-P) ²	Both sides	1.25	10
15	St. Marks Trail	St. Marks	Tallahassee	Wakulla and Leon Counties	Independent alignment (E)	None	27	10
16	Upper Tampa Bay Trail	Memorial Hwy	North of Ehrlich Rd	Hillsborough County	Independent alignment (E)	Both sides	8	10
17	West Orange Trail	Oakland	North of Apopka	Orange County	Independent alignment (E)	One side	19	10

¹ P = Programmed facility, E = existing facility

² An extension from Lake Beresford Park to CR 4142 (French Avenue) is programmed for the Spring to Spring Trail.

Data collection consisted of three components: intercept surveys, in-office data (U.S. Census data and map reviews), and field data (windshield surveys and detailed multi-modal level of service data). The intercept surveys were conducted along each corridor and included questions about the specific trip being taken (trip length, trip purpose) and respondent demographics. Census data and map reviews were used to obtain data on population and employment. Field data collection resulted in the level of service and network friendliness information.

Energy Conservation and Savings: Reducing the Usage of Petroleum-based Fuels

For the purposes of this Phase I Study, the metric for energy conservation and savings will be the Florida average at-the-pump cost of regular unleaded gasoline. This is a conservative metric (approximately \$3.00 per gallon at the time of this writing) which does not include the full societal cost of the usage of petroleum-based fuels. There are a host of references that estimate the full societal cost (a recent example being the National Cooperative Highway Safety Program Report 552) which include factors such as federal subsidies for oil and gas exploration, source development and protection, refinement and distribution. Externalities of petroleum-based fuel costs for domestic personal surface transportation also include the incremental cost (with respect to the bicycle) of construction and maintenance of transportation infrastructure (e.g. pavement lanes, parking, etc.).

The calculation of energy conservation and savings requires several key pieces of information, including fuel costs, recreational and utilitarian bicycle trip lengths, and fuel economy. The researchers obtained this information from various sources, as discussed in the following paragraphs.

The fuel cost at the pump, \$3.00 per gallon for regular gasoline, is a directly observable value, easily obtained from several sources. Because it represents the cost for regular gasoline, and since medium and premium grade gasoline is typically ten to twenty cents more expensive per gallon, it underestimates the actual average costs being paid by motorists for gasoline around the state.

An average recreational trip length of 5 miles and an average utilitarian trip (shopping, commuting to school or work, running errands, etc.) length of 3 miles were used. These trip

lengths were obtained from a 2002 phone survey of Florida residents within four Metropolitan Statistical Areas.²⁵ These values are also considered conservative. An internet survey conducted as part of this *Conserve by Bicycle Program Study* found much higher trip lengths for both recreational and utilitarian trips. This internet survey also found the length of the trips depended on the perceived quality of the bicycle facility provided, with longer utilitarian trips occurring on shared use paths. The *Conserve by Bicycle Study* survey was advertised through bicycling clubs and advocacy organizations, and by word of mouth. Consequently, those responding to the survey were likely to be more avid cyclists than those responding to the 2002 phone survey. Nonetheless, it provides an indication that actual average utilitarian trip lengths are significantly higher than those used for calculating energy savings in this section of the Phase I report.

The average fuel economy used for the energy conservation estimates is 20 miles per gallon (mpg).²⁶ This takes into account the average fuel economy of passenger cars (22.9 mpg) and two-axle, four-tire trucks (16.8 mpg). The 20 mpg value is considered conservative for this study because of the average trip lengths associated with bicycle travel. Bicycling trips are typically shorter than trips in motor vehicles; replacing these shorter trips (particularly those involving cold starts) will represent greater fuel savings than that represented by the average car/light truck fuel economy.

The calculated energy conservation and savings in this section are conservative because utilitarian trip lengths will likely increase above three miles as more Floridians start bicycling.

Preliminary Evaluation Results

The “before” data collected on these corridors were used to develop the models that measure corridor-level mode shift as a result of investing in various types of bicycle facilities. The model development process, specific utility equations, and model terms are discussed below.²⁷

²⁵ Center for Urban Transportation Research. *Bicycle and Pedestrian Travel: Exploration of Collision Exposure in Florida*. University of South Florida, Tampa, FL, 2002.

²⁶ Davis, S., S. Diegel, Oak Ridge National Laboratory, *TRANSPORTATION ENERGY DATA BOOK: EDITION 26*, prepared for Office of Planning, Budget Formulation and Analysis, Energy Efficiency and Renewable Energy, U.S. Department of Energy, 2007.

²⁷ The researchers would like to acknowledge the efforts and budgetary contribution of FDOT District 7 in the development of both this model and the induced recreational demand model discussed later in this Phase I report.

Mode Shift Model Development

The researchers used the NLOGIT 3.0 software package to model mode shift. The data set consisted of the combined survey responses from the seventeen corridors listed in Table 2-1. Responses which stated a trip purpose (Question #5 on the survey) of “Recreation” were used in the development of an induced recreational/exercise trips model (detailed later in this Phase I report) but not in the mode shift model, because the mode shift model pertains to utilitarian trips. The data set included responses from

- 1,554 motorists,
- 55 transit riders,
- 11 bicyclists, and
- 21 pedestrians.

While this represents a limited dataset, it includes all the data available for this study. Additional data for model refinement will be collected during Phase 3 of the District 7 study and Phase II of this Conserve by Bicycle Program Study.

Model Form

The proposed Phase I mode shift model provides users the ability to predict the number of existing motorized trips that will be shifted to non-motorized modes due to the enhancement, construction, or provision of bicycle and pedestrian facilities along a corridor.

The mode shift model may take the form of either a traditional multinomial logit or a nested logit model. The traditional multinomial logit model of mode choice takes the following form:

The preliminary model forms and models were developed during the District 7 project *Predicting Non-motorized Trips at the Corridor/Facility Level: The Bicycle & Pedestrian Mode Shift and Induced Travel Models* (Phases 1 and 2).

$$P(i) = \frac{e^{\beta'x}}{\sum_{i=1}^m e^{\beta'x}} \quad (\text{Eq. 2-1})$$

where

$P(i)$	=	probability that mode i is chosen for a trip within the corridor (in other words, the mode share)
e	=	base of natural logarithms, approximately 2.718
β	=	vector of model coefficients
x	=	matrix of explanatory variables including socio-economic variables, trip characteristics, and level of service variables
m	=	number of modes
$\beta'x$	=	utility equation for any given mode

This is the classic multinomial logit model that is used as standard practice for estimating modal split. The model predicts changes in the probability that a trip will be undertaken on a certain mode in response to changes in explanatory factors or variables (depicted by matrix x).

Nested logit models, which have hierarchical structures and are designed to capture similar alternatives in the choice set, were also developed and estimated. An example of a nested structure appears in Figure 2-15. The example shows that the user first makes a choice between motorized and non-motorized modes. If the user chooses motorized, then he/she chooses between the car and bus modes. If the user chooses non-motorized, then he/she chooses between the bike and walk modes.

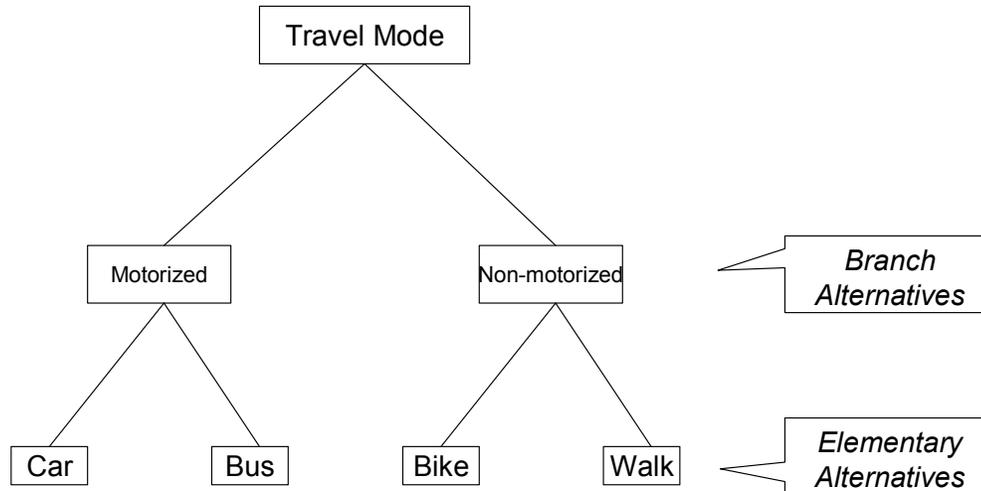


Figure 2-15 Example of a nested logit model structure

Initial models were developed using both the multinomial and nested logit forms. Examination of the outputs revealed that the nested logit model form would collapse to the multinomial logit form. Therefore, the multinomial logit form was chosen for further model development.

Theoretical Utility Equations

The variables described in the preceding section are incorporated into the theoretical utility equations for the motor vehicle (MV), transit (T), bicycle (B), and pedestrian (P) modes as follows:

$$U_{MV} = f(\text{Trip Length, Income, Population Density, Employment Density, Motor Vehicle LOS, Network Friendliness, Bicycle Friendly Community}) \quad (\text{Eq. 2-2})$$

$$U_T = f(\text{Trip Length, Income, Population Density, Employment Density, Transit QOS, Motor Vehicle LOS, Network Friendliness, Bicycle Friendly Community}) \quad (\text{Eq. 2-3})$$

$$U_B = f(\text{Trip Length, Income, Population Density, Employment Density, Bicycle LOS, Network Friendliness, Transit QOS, Bicycle Friendly Community}) \quad (\text{Eq. 2-4})$$

$$U_P = f(\text{Trip Length, Income, Population Density, Employment Density, Pedestrian LOS, Network Friendliness, Transit QOS, Bicycle Friendly Community}) \quad (\text{Eq. 2-5})$$

Mode share =

$$p(K) = \frac{e^{U_k}}{\sum_x e^{U_x}} \quad (\text{Eq. 2-6})$$

Mode Shift Model

Dozens of combinations of variables and variable transformations were tested. The utility equations in the recommended model consist of the following constants and variables.

CAR	TRANSIT	BIKE	WALK
Acar		Abike	
	MV_LOS_T	BikeConn	PedConn
	BusQOS	Eff_BLOS	Eff_PLOS
	Trip_Len	Trip_Len	Trip_Len
		Pop_Emp	Pop_Emp

where

MV_LOS_T = Motor vehicle LOS for the corridor (= “A” if the corridor has rapid transit)

BusQOS = Transit quality of service

Trip_Len = Trip length for each individual

BikeConn = Network friendliness for the bike mode

Eff_BLOS = Positive effective bicycle LOS

PedConn = Network friendliness for the walk mode

Eff_PLOS = 0.50 for an existing independent alignment; otherwise the pedestrian LOS score

Pop_Emp = Product of the population and employment divided by the influence area

Acar, Abike = Mode-specific constants for the car and bike modes, respectively

Most variables pertained to specific corridors. The exception is trip length, which pertained to individual respondents. The variables in the utility equations are discussed below.

Motor Vehicle LOS (MV_LOS_T) - The motor vehicle LOS for each corridor was obtained from the generalized tables in FDOT's *Quality/Level of Service Handbook*. It was expected that this variable would have a negative coefficient, as higher numerical values correspond to a worse motor vehicle LOS and would reduce utility. The motor vehicle LOS was set to "A" for the US 1 corridor in Miami (#12 in Table 2) because that corridor is serviced by Metrorail, a rapid transit line operating in its own right-of-way. As such, the utility of the transit mode on the US 1 corridor would not be adversely affected by degradations in the motor vehicle LOS on US 1.

Transit Quality of Service (BusQOS) - The transit quality of service for each corridor was assigned a value of A, B, C, D, E, or F according to service headways, as defined in FDOT's *Quality/Level of Service Handbook*. It was expected that this variable would have a negative coefficient, as higher numerical values correspond to a worse transit quality of service and would reduce utility.

The *Transit Capacity and Quality of Service Manual (TCQSM)* contains six transit service measures:

- Service frequency
- Hours of service
- Areas served by transit
- Passenger loading
- Reliability
- Travel time relative to the automobile

The FDOT's *Quality/Level of Service Handbook* simplifies the Transit Quality of Service so that it can be calculated from the frequency of transit service. This simplified application of the Transit Quality of Service was used in the mode shift model.

Trip Length (Trip_Len) - Trip lengths were calculated using the origins and destinations provided by the survey respondents. Over 400 respondents did not provide sufficient

information for trip lengths to be calculated. It was expected that trip length would have a positive coefficient for the bus mode and negative coefficients for the bike and walk modes.

Network Friendliness (BikeConn, PedConn) - The network friendliness for each corridor was calculated according to the procedure in Appendix G. It was expected that this variable would have a positive coefficient for both the bicycle and walk modes, as higher values indicate greater friendliness and would increase utility of bicycling and walking.

Table 2-2 presents the network friendliness values for each corridor.

Table 2-2 Network Friendliness Values

ID	Name	From	To	Bicycle	Pedestrian
1	16 th St S	Pinellas Point Dr	62 nd Ave S	0.67	0.68
2	31 st St N	Central Ave	5 th Ave N	0.67	0.70
3	Bruce B. Downs Blvd	Amberly Dr	Hunter's Green Dr	0.33	0.30
4	Bruce B. Downs Blvd	Hillsborough County line	SR 54	0.24	0.24
5	CR 550	Shoal Line Blvd	US 19	0.25	0.24
6	Elgin Blvd	Deltona Blvd	Mariner Blvd	0.37	0.37
7	Lutz-Lake Fern Rd	Gunn Hwy	Dale Mabry Hwy	0.20	0.21
8	US 41	Kennedy Blvd	Bearss Ave	0.44	0.46
9	SR 60	Kings Ave	Kingsway Rd	0.24	0.24
10	U.S. Alt. 19 (Pinellas Trail)	Union St	Orange St	0.24	0.25
11	20 th St	Adamo Dr	Causeway Blvd	0.23	0.24
12	US Route 1 (M Path)	SW 67 th Ave	SW 7 th St	0.30	0.31
13	Sunrise Blvd	Hiatus Rd	Pine Island Rd	0.38	0.39
14	Spring to Spring Trail	Gemini Springs Park	DeBary Hall	0.54	0.54
15	St. Marks Trail	St. Marks	Tallahassee	0.29	0.26
16	Upper Tampa Bay Trail	Memorial Hwy	North of Ehrlich Rd	0.77	0.77
17	West Orange Trail	Oakland	North of Apopka	0.23	0.19

Effective Bicycle LOS (Eff_BLOS) - The effective bicycle LOS took on these values:

1. 0.50 for an existing independent alignment
2. 0.75 to 2.00 for an existing shared use path adjacent to roadway, depending on the distance from the roadway
3. calculated segment bicycle LOS + 2.00 for a corridor with existing bicycle lanes or with no bicycle facilities

This variable was expected to have a negative coefficient, as higher numerical values indicate a worse bicycle LOS and would reduce utility.

Effective Pedestrian LOS (Eff_PLOS) - The effective pedestrian LOS took on these values:

1. 0.50 for an existing independent alignment
2. calculated segment pedestrian LOS + 1.00 for a corridor with a shared use path adjacent to roadway, existing bicycle lanes, or with no bicycle facilities

This variable was expected to have a negative coefficient, as higher numerical values indicate a worse pedestrian LOS and would reduce utility.

Population and Employment Density (Pop_Emp) – For each corridor, the population of the network analysis zone was first multiplied by the employment in the network analysis zone. Next, the result was divided by the area (in square miles) of the network analysis zone to obtain a second result. Finally, the second result was divided by 1,000. It was expected that this variable would have a positive coefficient, as higher population and employment densities translate into higher utilities of bicycling and walking (Figure 2-12).

Mode Shift Model Summary

A summary of the coefficients, t statistics (b/St.Er.) and p-values ($P[Z > z]$) for the recommended model appears below. As shown in the summary, “R-sqrd” (or “R2”) denotes the likelihood ratio index and is a measure of the model’s goodness-of-fit.

$$R2 = 1 - \text{LogL} / \text{LogL}^* \quad (\text{Eq. 2-7})$$

where $\text{LogL} =$ Log-likelihood function of the estimated model

$\text{LogL}^* =$ Log-likelihood function of a model with no coefficients

Values close to 1 mean that the estimated model is much improved compared to a model with no coefficients. Values close to 0 mean that the estimated model is only slightly improved compared to a model with no coefficients.

Normal exit from iterations. Exit status=0.

```

+-----+
| Discrete choice (multinomial logit) model |
| Maximum Likelihood Estimates |
| Model estimated: Apr 19, 2007 at 05:17:42PM. |
| Dependent variable Choice |
| Weighting variable None |
| Number of observations 1176 |
| Iterations completed 11 |
| Log likelihood function -148.1066 |
| R2=1-LogL/LogL* Log-L fncn R-sqrd RsqAdj |
| No coefficients -1630.2822 .90915 .90875 |
| Constants only. Must be computed directly. |
| Use NLOGIT ;...; RHS=ONE $ |
| Response data are given as ind. choice. |
| Number of obs.= 1642, skipped 466 bad obs. |
+-----+

```

Variable	Coefficient	Standard Error	b/St.Er.	P[Z >z]
ACAR	1.39757217	.75430193	1.853	.0639
MVLOS2	-.39824639	.26513941	-1.502	.1331
BUSQOS2	-.25018621	.30099798	-.831	.4059
TRIPLEN2	.02946619	.03080028	.957	.3387
ABIKE	-2.90605148	2.00072144	-1.453	.1464
BIKECON3	5.70249163	3.50017580	1.629	.1033
BIKELOS3	-.72199734	.29456809	-2.451	.0142
TRIPLEN3	-.21672853	.11921541	-1.818	.0691
POPEMP3	.350198D-04	.237897D-04	1.472	.1410
PEDCON4	.71270415	1.57427085	.453	.6508
PEDLOS4	-.23854978	.17061234	-1.398	.1621
TRIPLEN4	-.74716694	.19688391	-3.795	.0001
POPEMP4	.314793D-04	.780862D-05	4.031	.0001

where

Acar = Mode-specific constant for the car mode

MV_LOS2	= Coefficient for motor vehicle LOS for the bus mode
BusQOS2	= Coefficient for transit quality of service
TripLen2	= Coefficient for trip length for the bus mode
Abike	= Mode-specific constant for the bike mode
BikeCon3	= Coefficient for network friendliness for the bike mode
BikeLOS3	= Coefficient for bicycle level of service
TripLen3	= Coefficient for trip length for the bike mode
PopEmp3	= Coefficient for population and employment density for the bike mode
PedCon4	= Coefficient for network friendliness for the walk mode
PedLOS4	= Coefficient for pedestrian level of service
TripLen4	= Coefficient for trip length for the pedestrian mode
PopEmp4	= Coefficient for population and employment density for the walk mode

By substituting the coefficients from above, the utility equations in the recommended model may be written as follows:

$$U(\text{car}) = 1 \quad (\text{Eq. 2-8})$$

$$U(\text{transit}) = \exp(-1.332 - 0.398 * \text{motor vehicle LOS} - 0.250 \text{ transit QOS} + 0.029 \text{ trip length}) \quad (\text{Eq. 2-9})$$

$$U(\text{bike}) = \exp(-6.584 + 5.702 \text{ bike network friendliness} - 0.722 \text{ bicycle LOS} - 0.217 \text{ trip length} + 3.50 \times 10^{-5} * \text{population} * \text{employment density}) \quad (\text{Eq. 2-10})$$

$$U(\text{walk}) = \exp(-4.131 - 0.239 \text{ pedestrian LOS} - 0.747 * \text{trip length} + 3.15 \times 10^{-5} * \text{population} * \text{employment density}) \quad (\text{Eq. 2-11})$$

Variables Not Included in Model

The car mode was taken to be the baseline, so no variables were included in that utility equation. The utility equations for the other modes express their utilities relative to the car mode.

NLOGIT 3.0 was unable to build utility equations that were specified to include all of the variables. This is likely the result of two artifacts of the Phase I data set:

1. Limited variability in the values of the variables (except for trip length, all of the variables were corridor-level, so the variable had the same value for all participants in that corridor), and
2. Limited number of utilitarian transit riders, bicyclists, and pedestrians in the data set.

Other variables not included are described below.

Household Income – The inclusion of household income resulted in a positive coefficient for pedestrian LOS, which would have indicated that as pedestrian LOS becomes worse, the utility for the walk mode would increase. This contradicts the expected relationship between pedestrian LOS and utility and is likely an artifact of the data: (1) there was not a clear pattern between pedestrian LOS and household income (Figure 2-16) (Pearson correlation coefficient $r = 0.099$) and (2) household income pertained to the area surrounding the survey location, not the individual completing the survey.

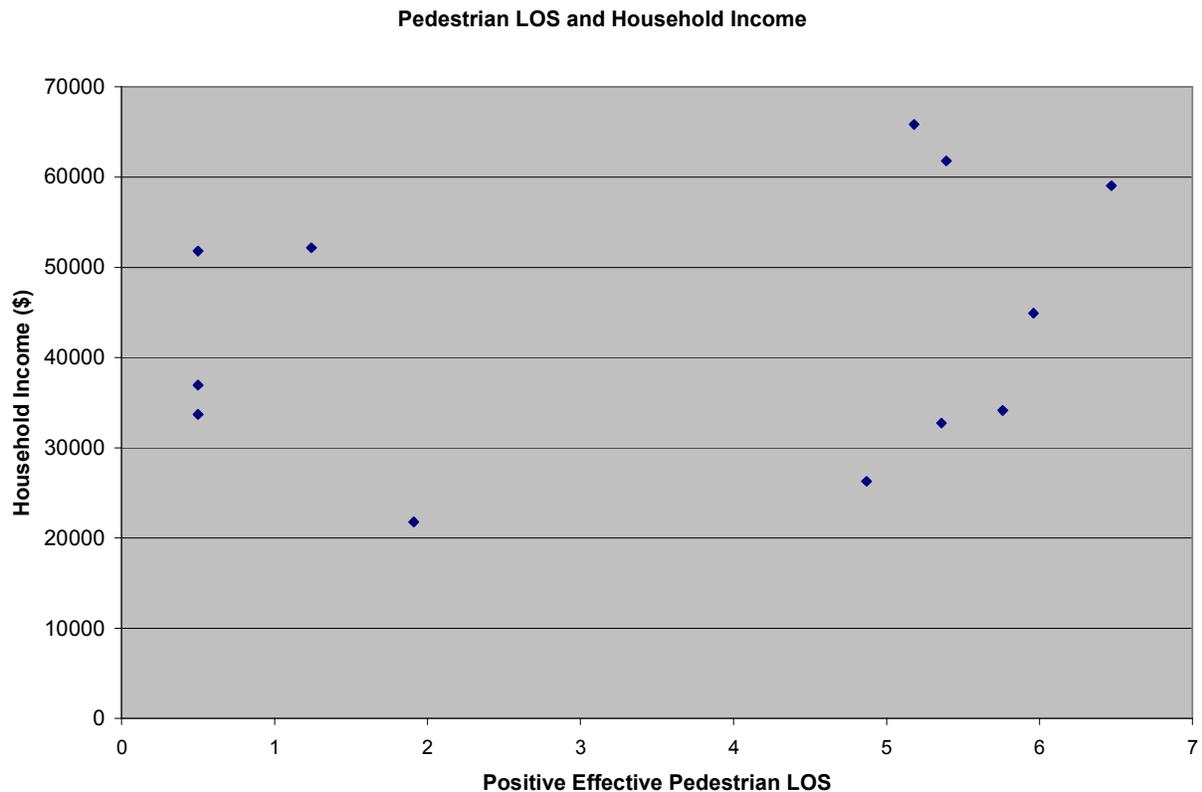


Figure 2-16 Pedestrian LOS and household income

Bicycle Friendly Community – This variable had a value of “1” if the corridor was in a bicycle-friendly community, as designated by the League of American Bicyclists. Otherwise, the variable had a value of “0.” Only two facilities, 16th Street and 31st Street, were in a bicycle-friendly community (Table 2-1), St. Petersburg.

Mode Shift Model Sensitivity Analysis

The results of mode shift model sensitivity analyses are presented in Appendices H and I. More detailed explanations accompany each Appendix:

Appendix H Varying facility type

Appendix I Varying trip length

The values of trip length, as shown in the sensitivity charts, are all within the ranges of the respective variables in the data used for model development.

Examples of Mode Shift Calculation/Estimation

To estimate the energy savings resulting from the provision of a bicycle facility, it is necessary to first predict how many individuals will switch to bicycling (from motor vehicles) as a result of the provision of the bicycle facility. This example calculation shows how the mode shift model is used to predict the mode shift.

This example uses the recommended model on Corridor #8, Nebraska Avenue in Tampa, to predict the mode shift of adding different types of bicycle facilities. Nebraska Avenue is a four-lane urban arterial (Figure 2-17). The cross-section is a mix of four-lane divided and four-lane undivided. The surrounding land uses are a mix of commercial and residential at a moderate to high density in terms of Florida metropolitan areas.

The input variable values are shown in Table 2-3.



Figure 2-17 Nebraska Avenue, Tampa

Table 2-3 Input Variable Values, Nebraska Avenue Corridor, Tampa

Type of Bicycle Facility	Baseline – Shared Use Lane	Bicycle Lane or Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Bicycle Network Friendliness	0.44	0.45	0.48	0.51
Effective Bicycle LOS	6.85	5.83	2.00	0.50
Pedestrian Network Friendliness	0.46	0.46	0.49	0.53
Effective Pedestrian LOS	4.87	4.76	4.76	0.50

	Values Common to All Conditions
Motor Vehicle LOS	C
Transit Quality of Service	D
Trip Length (average of all travelers surveyed) (miles)	9.07
Population * Employment Density (per square mile)	96,987
No. of Travelers per Weekday, all modes	32,030

The utility equations for the recommended model, shown in Equations 2-8 through 2-11, are repeated here for convenience:

$$U(\text{car}) = 1 \quad (\text{Eq. 2-8})$$

$$U(\text{transit}) = \exp(-1.332 - 0.398 * \text{motor vehicle LOS} - 0.250 \text{ transit QOS} + 0.029 \text{ trip length}) \quad (\text{Eq. 2-9})$$

$$U(\text{bike}) = \exp(-6.584 + 5.702 \text{ bike network friendliness} - 0.722 \text{ bicycle LOS} - 0.217 \text{ trip length} + 3.50 \times 10^{-5} * \text{population} * \text{employment density}) \quad (\text{Eq. 2-10})$$

$$U(\text{walk}) = \exp(-4.131 - 0.239 \text{ pedestrian LOS} - 0.747 * \text{trip length} + 3.15 \times 10^{-5} * \text{population} * \text{employment density}) \quad (\text{Eq. 2-11})$$

Substituting the values from the “Baseline Condition” and “Values Common to All Conditions” columns of Table 2-3 into the utility equations results in:

$$U(\text{car}) = 1 \quad (\text{Eq. 2-12})$$

$$U(\text{transit}) = 0.0943 \quad (\text{Eq. 2-13})$$

U (bike) = 5.05×10^{-4} (Eq. 2-14)

U (walk) = 1.69×10^{-4} (Eq. 2-15)

The sum of the utilities is 1.0950. The corresponding mode shares are:

- Car 0.9133 (=1/1.0950)
- Transit 0.0861 (=0.0943/1.0950)
- Bike 4.62×10^{-4} ($(5.05 \times 10^{-4})/1.0950$)
- Walk 1.54×10^{-4} ($(1.69 \times 10^{-4})/1.0950$)

These mode shares are multiplied by the total number of weekday travelers by all modes, 32,030, to obtain the predicted number of people traveling by each mode:

- Car 29,252
- Transit 2,759
- Bike 15
- Walk 5

These calculations are repeated for other bicycle facility types that could be built in the roadway corridor. As improvements from no bicycle facilities to bicycle lanes, shared use paths adjacent to roadways, and independent alignments result in better effective bicycle LOS and higher bicycle connectivity, the relative utility of the bike mode increases, so the predicted bike mode share also increases, resulting in a higher number of bicyclists. The predicted numbers of people traveling by each mode according to bicycle facility type are given in Table 2-4.

Table 2-4 Predicted Travel by Mode, Nebraska Avenue Corridor, Tampa

Mode	Baseline Condition – Shared Use Lane	Bicycle Lane or Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Car	29,252	29,235	28,712	27,409
Transit	2,759	2,757	2,708	2,585
Bike	15	33	605	2,023
Walk	5	5	5	14

Using the above predictive methodology one can then calculate the energy savings in dollars resulting from the resulting mode shift that will occur based on these various bicycle facility

types and the existing number of bicyclists “converted” from the automobile mode. Given the following key pieces of information:

- an average utilitarian trip length of 3 miles²⁸;
- an average of 1.43 people per motor vehicle²⁹;
- 20 miles to the gallon fuel economy³⁰; and,
- \$3.00 per gallon

the energy and costs savings can be obtained (Table 2-5).

Table 2-5 Energy Savings per Year Resulting from Mode Shift, Nebraska Avenue Corridor, Tampa

	Baseline - Shared Use Lane	Bicycle Lane/Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Predicted Number of Cyclist Trips per Year	9,068	20,037	370,882	1,240,672
Gallons of Gas Saved	N/A	1,151	37,953	129,199
Fuel Costs Saved	N/A	\$3,452	\$113,858	\$387,596

The above savings are for one example Florida corridor. A step-by-step description of the calculations is given in Appendix M. The predicted savings would vary depending upon the specific characteristics of the study roadway corridor and surrounding area. Two more examples are provided below, so that the reader can see how the predicted energy savings vary.

The second example shows the predicted energy savings for Corridor #15, the St. Marks Trail, between Tallahassee and Wakulla (Figure 2-18). The St. Marks Trail is parallel to

²⁸ Center for Urban Transportation Research. *Bicycle and Pedestrian Travel: Exploration of Collision Exposure in Florida*. University of South Florida, Tampa, FL, 2002.

²⁹ E-mail from Sara Hendricks, Center for Urban Transportation Research, to Herman Huang, Sprinkle Consulting, Inc.

³⁰ Davis, Stacy C. and Susan W. Diegel. *Transportation Energy Data Book: Edition 25*. Report No. ORNL-6974. Oak Ridge National Laboratory, Oak Ridge, TN, 2006.

Woodville Highway, a two-lane rural arterial. Table 2-6 shows input values for the St. Marks Trail.



Figure 2-18 St. Marks Trail, Tallahassee

Table 2-6 Input Variable Values, St. Marks Trail Corridor, Tallahassee

Type of Bicycle Facility	Baseline – Shared Use Lane	Bicycle Lane or Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Bicycle Network Friendliness	0.25	0.29	0.40	0.83
Effective Bicycle LOS	7.78	6.08	2	0.5
Pedestrian Network Friendliness	0.25	0.26	0.35	0.56
Effective Pedestrian LOS	6.08	5.65	5.65	0.5

	Values Common to All Conditions
Motor Vehicle LOS	C
Transit Quality of Service	N/A
Trip Length (average of all travelers surveyed) (miles)	13.98
Population * Employment Density (per square mile)	2
No. of Travelers per Weekday, all modes	8,380

The resulting energy savings are shown in Table 2-7.

Table 2-7 Energy Savings per Year Resulting from Mode Shift, St. Marks Trail Corridor, Tallahassee

	Baseline - Shared Use Lane	Bicycle Lane/Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Predicted Number of Cyclist Trips per Year	5	22	793	27,044
Gallons of Gas Saved		2	83	2,836
Fuel Costs Saved		\$5	\$248	\$8,508

The third example shows the predicted energy savings for the M Path in Miami. The M Path runs generally parallel to US 1, a six-lane divided urban arterial roadway (Figure 2-19). The Metrorail rapid transit route, operated by Miami-Dade Transit, uses elevated tracks adjacent to, and at some locations, directly above, the M Path. Table 2-8 shows input values for the M Path.



Figure 2-19 M Path, Miami

Table 2-8 Input Variable Values, M Path Corridor, Miami

Type of Bicycle Facility	Baseline – Shared Use Lane	Bicycle Lane or Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Bicycle Network Friendliness	0.30	0.31	0.33	0.33
Effective Bicycle LOS	8.33	7.28	1.24	0.5
Pedestrian Network Friendliness	0.31	0.31	0.33	0.34
Effective Pedestrian LOS	7.25	7.09	7.09	0.5

	Values Common to All Conditions
Motor Vehicle LOS	F
Transit Quality of Service	A
Trip Length (average of all travelers surveyed) (miles)	10.96
Population * Employment Density (per square mile)	124,556
No. of Travelers per Weekday, all modes	132,448

The resulting energy savings are shown in Table 2-9.

Table 2-9 Energy Savings per Year Resulting from Mode Shift, M Path Corridor, Miami

	Baseline - Shared Use Lane	Bicycle Lane/Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Predicted Number of Cyclist Trips per Year	6,337	14,317	1,232,728	2,074,560
Gallons of Gas Saved		837	128,642	216,947
Fuel Costs Saved		\$2,511	\$385,927	\$650,839

For a summary of the potential fuel savings for all the study corridors see Appendix M.

The model described above provides reasonable predictions for the mode shift from automobile to bicycle that will result from providing or improving facilities for bicyclists along a corridor. However, to validate that the predictions are accurate, additional data should be collected after the programmed facilities are installed. This Phase II data will result in further refinement of the model.

Recreation and Exercise

According to the U.S. Centers for Disease Control and Prevention, in 2005, about 46 percent of Floridians engaged in the level of physical activity recommended by the Centers for Disease Control.^{31, 32} The remaining 54 percent had insufficient physical activity. This statistic is significant in that the lack of physical activity increases the instances of chronic diseases, such as heart disease, stroke, colon cancer, diabetes, and osteoporosis. Children who become obese as a result of poor diet and lack of exercise are particularly at risk of contracting Type 2 diabetes. In addition to health impacts on individuals, future increases in the rates of these conditions will lead to an ever-increasing burden in Florida's health care costs.

Two purposes of the Conserve by Bicycle Program are to:

- *Provide recreational opportunities for Florida's residents and visitors, and*
- *Provide healthy transportation and recreation alternatives to help reduce the trend toward obesity and reduce long-term health costs.*

³¹ <http://apps.nccd.cdc.gov/PASurveillance/StateSumV.asp>

³² The Centers for Disease Control defines "recommended physical activity" as

Reported moderate-intensity activities in a usual week (i.e., brisk walking, bicycling, vacuuming, gardening, or anything else that causes small increases in breathing or heart rate) for at least 30 minutes per day, at least 5 days per week; or vigorous-intensity activities in a usual week (i.e., running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate) for at least 20 minutes per day, at least 3 days per week or both. This can be accomplished through lifestyle activities (i.e., household, transportation, or leisure-time activities).

These purposes are echoed in the study goal of determining:

- *How, and under what circumstances, the construction of bicycling facilities can provide more opportunities for recreation and how exercise can lead to a reduction of health risks associated with a sedentary lifestyle.*

Background

As stated above a lack of physical activity has been linked to numerous health related risks. This section details some of those risks and describes how increases in physical activity can help address them.

In 1996, the U.S. Department of Health and Human Services issued a Report of the Surgeon General entitled “Physical Activity and Health,” that linked a variety of health issues to lack of physical activity. The report summarized a wide array of research and concluded that regular physical activity can “greatly reduce the risk of coronary heart disease, the leading cause of death in the United States.”³³ Regular physical activity also “reduces the risk of developing diabetes, hypertension, and colon cancer; enhances mental health, fosters healthy muscles, bones and joints; and helps maintain function and preserve independence in older adults.”³⁴

In light of the broad benefits associated with regular physical activity, the Centers for Disease Control also issued a recommendation that “Every U.S. adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all days of the week.” This recommendation focused on the benefits derived by presently inactive people beginning and maintaining activity of moderate intensity. The recommendation cited evidence that “low- to moderate- intensity physical activity levels are more likely to be continued than high-intensity activities.” The recommendation cited numerous impediments to physical activity, including environmental factors such as “a lack of bicycle trails and walking paths away from traffic, inclement weather and unsafe neighborhoods.” The recommendations specifically

³³ U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996. p. iii.

³⁴ U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.

identified cycling as one kind of moderate-intensity activity that will help people realize the numerous benefits of becoming active. The recommendation also identified specific levels of bicycling that are equivalent to the recommended daily “dose” of physical activity: Moderate bicycling (5 miles in 30 minutes) has a benefit equivalent to a shorter period of more vigorous bicycling (4 miles in 15 minutes).

This recommendation from the CDC provides a standardized unit of activity that is accepted to yield a complex but accepted health benefit. Some studies have taken this measure as a unit of benefit for changes in the built environment, either with regard to meeting the recommended dose, or extrapolating further to calculate the difference in health care costs incurred between those people who meet the CDC’s recommended level of activity and those who do not. For example, in 2003, James Sallis and others summarized research linking urban form to walking and biking activity and estimated a mean difference in activity levels between people who live in “walkable neighborhoods” and those who do not; the mean difference they found translates into 15-30 minutes of walking per week, or, an entire day’s dose of physical activity being accounted for in the difference.³⁵

To give another example of how the benefits of improving the built environment can be calculated, if a study can predict how much time will be spent cycling, or miles will be ridden, as a result of some facility construction, then that new activity can be estimated as a percentage of meeting the activity threshold. The FHWA study *Characteristics of Emerging Road and Trail Users and Their Safety*, published in 2004, found that the average bicycle rider on a shared use path is riding at a speed of about 10 miles per hour³⁶, which is equal to the 5 miles in 30 minutes recommended by the CDC. Therefore, on average, every 5 miles ridden on a shared use path is equal to one person meeting his or her recommended daily dose of physical activity.

Researchers have also made efforts to further quantify benefits of meeting the recommended levels of physical activity. Efforts have been made to also estimate the health care costs associated with lack of physical activity, and thereby quantify some savings to be gained by helping more people meet the recommended levels of physical activity. Report 552 from the

³⁵ Sallis, James F., L.D. Frank, B.E. Saelens, and M.K. Kraft, M.K. Active Transportation and Physical Activity: Opportunities for Collaboration and Public Health Research. *Transportation Research Part A*, 2004, pp. 257ff.

³⁶ Landis, Bruce W., Theodore A. Petritsch, and Herman F. Huang. *Characteristics of Emerging Road and Trail Users and Their Safety*. Federal Highway Administration, McLean, VA, 2004, p. 75.

National Cooperative Highway Research Program, *Guidelines for Analysis of Investments in Bicycle Facilities*, summarizes various studies that have compared health care expenditures for people who are active to those for people who are inactive. These studies found a range of per-capita annual health savings, ranging from \$19 in the State of Washington to \$1,175 in Michigan; with a median value of \$128 across ten studies.³⁷ In a similar effort, the Robert Wood Johnson Foundation funded the development of an on-line physical inactivity calculator that estimates the costs associated with physically inactive people in specific situations.³⁸

Statewide Estimates of Health Benefits

The health benefits of cycling activity in Florida can be estimated based upon the number of bicycling trips taken in each year (Table 1-1). To calculate the overall health benefits of cycling, each bike trip was taken to represent approximately half an hour of exercise and each half hour of exercise represents approximately \$0.49 of health benefit.³⁹ These values yield benefits of \$306 million and \$481 million dollars respectively in Florida in 1998 and 2002.

Literature Search

As part of the literature search, the researchers first reviewed numerous studies of the impacts of bicycle facilities on bicycle ridership. A few studies included counts of bicyclists on facilities. However, nothing was available to allow the researchers to predict how many bicyclists are likely to use a bicycle facility improvement, nor what health benefits would result. Therefore, preliminary methods for predicting the number of bicyclists and the accompanying health benefits were to be developed as part of Phase I of this study.

³⁷ Krizek, K., *et al.* *Guidelines for Analysis of Investments in Bicycle Facilities*. National Cooperative Highway Research Program Report 552. Transportation Research Board, Washington, DC, 2006, p. E-2.

³⁸ Chenoweth, Dr. David H., Department of Health Education and Promotion, East Carolina University, chenowethd@ecu.edu

³⁹ As mentioned above, Krizek *et al.* found that the median health benefit of being physically active is \$128 per person per year. Physically active is defined as participating in physical activity 5 times per week (for 30 minutes each time), which translates into 260 times per year. Dividing \$128 per year by 260 times per year yields approximately \$0.49 of health benefit per time (or bike trip).

The literature search pertaining to recreation and exercise appears in Appendix Q of this report.

Measurable Criteria

According to the Scope of Services, the Conserve by Bicycle Program Study:

- *Shall produce measurable criteria that can be used by [FDOT] to determine where and under what circumstances the construction of bicycling facilities will reduce energy consumption and the need for and cost of roadway capacity, as well as realizing the associated health benefits.*

To measure the health benefits of providing bicycle facilities, the number of people who will use bicycle facilities if they are provided must be known. Thus, measurable criteria for evaluating the energy conservation and savings associated with providing bicycle facilities are before-and-after bicycle counts and replaced activity. These are discussed below.

Before-and-After Bicycle Counts

Few people will engage in recreational bicycling in a shared lane with motor vehicle traffic because few people perceive that to be safe or comfortable. The provision of bicycle lanes and shared use paths will increase perceived safety and comfort on the part of the bicyclists, and more bicyclists will engage in recreational bicycling on those facilities. Before-and-after bicycle counts provide information on how many additional bicycle trips are being made as a result of a bicycle facility being provided.

Replaced Activity

The presence of a bicycle facility may motivate some individuals to opt for bicycling on the facility instead of pursuing another activity. Individuals can choose from among many options for leisure. These include riding a bicycle on a trail, driving to the park, staying at home and watching rented movies, to name just a few. Replaced activity may or may not result in health benefits. If a person rides a bicycle from his/her home to a trail and then back home, instead of driving to the park, then health benefits will result because the bicycle trip replaces the driving trip. On the other hand, if a person rides a bicycle on a trail instead of swimming at the

community pool, then health benefits may not result because one physical activity (bicycling) has replaced another (swimming).

The literature search described above found no information related to replaced activity. While the impact on improved public health is likely minimal, a specific study would be needed to confirm this.

Research Plan

To address the study goals, the extent of mode shift and induced recreational travel that result from the construction of bicycle facilities needs to be determined. That is, how many users will be mode-shifted from the motor vehicle mode to the bicycle mode? How many users will be induced to bicycle for recreational purposes? After determining the number of users that will be using the facility, the energy savings and health benefits for that facility can be calculated.

To answer these questions, the researchers collected “before” and “after” data on seventeen corridors (Table 2-1). The corridors were nominated by FDOT staff and by members of the Steering Committee. Some corridors were chosen because they currently have bicycle facilities (bicycle lane or shared use path). These were used as surrogate “after” data points. Other corridors were chosen because they are scheduled to receive a facility in the near future. These were used as “before” data points.

Induced Recreational Trips

To identify the specific factors that should be evaluated, the researchers consulted several groups: members of the Steering Committee, participants in the National ProWalk/ProBike Conference, and a variety of other transportation professionals from around the United States. They identified that the following characteristics of bicycle facilities influence their decisions to make recreational bicycle trips:

- Facility length
- Intersections/interruptions
- Amenities/points of interest
- # of other trail users
- Crime
- Scenery/aesthetics

- Density-weighted population
- Bicycle LOS

These characteristics are described below.

Facility Length The length of a facility is likely to impact the number of recreational bicyclists, as they have longer preferred riding lengths. Few recreational bicyclists will want to ride on a very short facility (below some minimum length) because it will not be worth the effort to get ready and to access the facility. As facility lengths increase, more recreational bicyclists will ride on those facilities. The increase in the number of additional recreational bicyclists opting to ride a portion of a facility eventually levels off, once facility length exceeds most recreational bicyclists' preferred riding lengths.

It should be noted that this, as well as the following discussions, relate to the number of users that would pass through one specific point on the facility. The total number of individuals using the facility will, in most cases, be greater than the number of riders passing any one point.

The expected relationship is shown graphically in Figure 2-20.

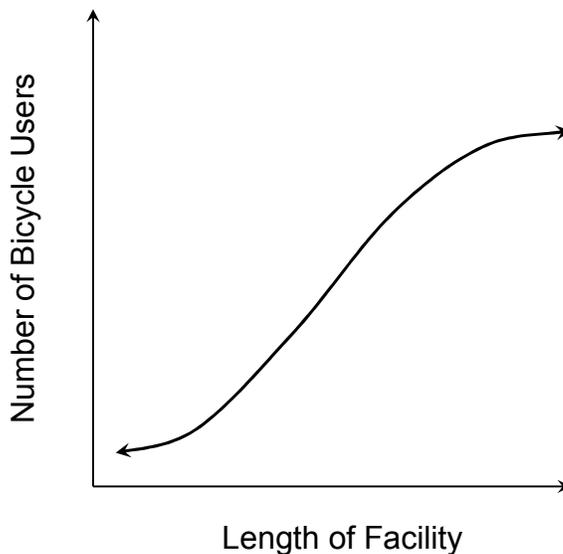


Figure 2-20 Number of bicycle users by length of facility

Intersections/Interruptions Recreational bicyclists prefer to ride on facilities with few interruptions such as intersections and driveways. These interruptions are potential conflict points between bicyclists and motorists. They are also potential delay points for bicyclists, in that bicyclists may be required to stop for a STOP sign, a traffic signal, or a car exiting a driveway. As the number of interruptions per mile increases, so does the number of potential conflict and delay points, and the facility becomes less attractive to ride on. Therefore, the number of recreational bicyclists is expected to decline as the number of interruptions per mile increases. The decline eventually levels off, as there will be a few recreational bicyclists who will ride no matter how many interruptions there are.

Figure 2-21 shows the expected relationship between the number of intersections/interruptions per mile and the number of recreational bicyclists using the facility.

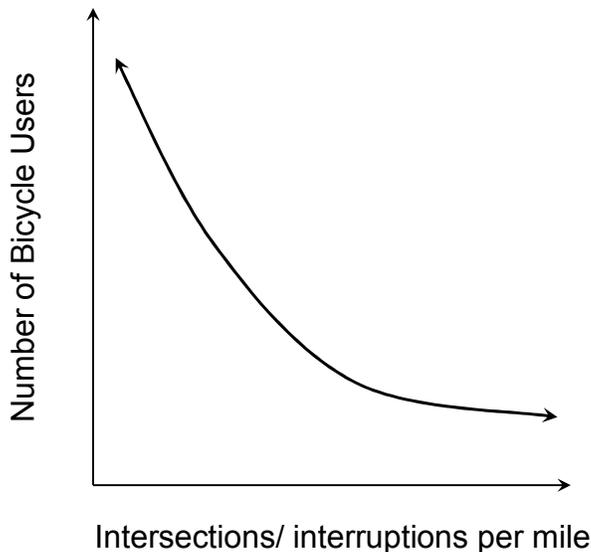


Figure 2-21 Number of bicycle users by interruptions per mile

Amenities/Points of Interest Recreational bicyclists like to ride on facilities where they can easily find places to rest. Hence, it is important for facilities to offer amenities such as benches, restrooms, drinking fountains, and other places to get water.

Bicyclists also like to have interesting destinations along their ride routes. Points of interest may include regional parks; scenic vistas such as beaches, causeways, water features; or other areas of interest such as revitalized downtowns, entertainment districts, historic areas, etc. These give recreational bicyclists something interesting and attractive to look at while riding. See also “Scenery/Aesthetics” later in this report.

Few, if any, recreational bicyclists will want to ride on a facility with no amenities or points of interest. As the number of amenities and points of interest per mile increases, more recreational bicyclists will ride on those facilities. The increase in the number of recreational bicyclists eventually levels off, once the facility becomes “saturated” with amenities and points of interest.

The expected relationship is shown graphically in Figure 2-22.

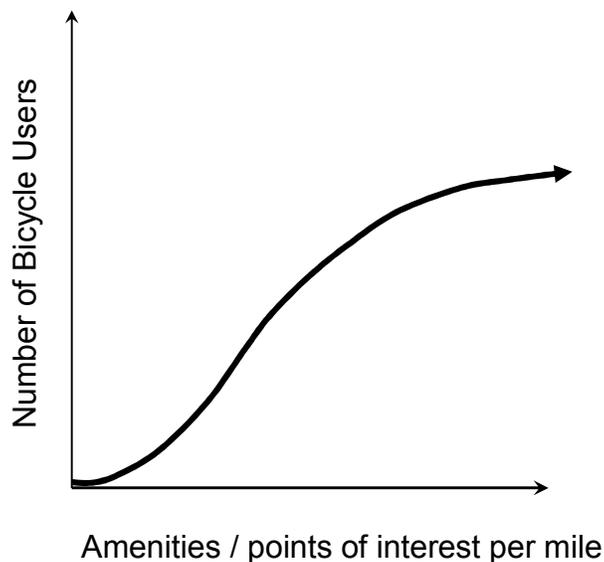


Figure 2-22 Number of bicycle users by number of amenities and points of interest per mile

Number of Other Trail Users While most recreational bicyclists enjoy the presence of some other users on a path, they do not like riding in congested conditions. However, recreational bicyclists may have to share the trail with other bicyclists as well as pedestrians, inline skaters, and other non-bicycle users. The recreational bicyclist may believe that these other users “get in the way.” For example, he or she may wish to pass two pedestrians walking abreast, either in the same direction or in the opposite direction. Some facilities may not be wide enough to permit this maneuver. As the number of pedestrians and others increases, there are more persons that “get in the way,” making the trail less desirable for recreational bicycling and leading to a decline in the number of recreational bicyclists. Wider trails have more room for all users, bicyclists and non-bicyclists, compared to narrower trails. Thus, the number of recreational bicyclists on a 20-ft trail is higher than that on a 10-ft trail, holding the number of non-bicyclist users constant.

Figure 2-23 shows the expected relationship between the number of recreational bicyclists and the number of other trail users. Each curve represents a different trail width.

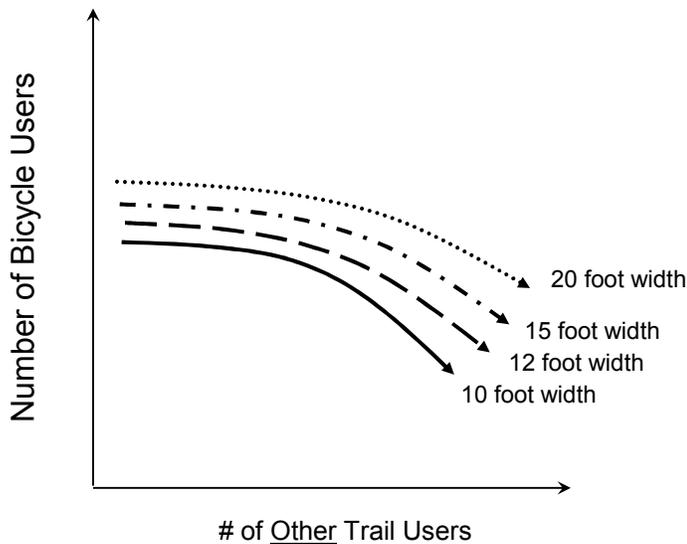


Figure 2-23 Number of bicycle users by number of other trail users and trail width

Crime Recreational bicyclists are more likely to ride on a facility if they perceive that they are safe from crime, not only while riding on the facility but also while riding to and from the facility. Conversely, they are less likely to ride on a facility if they perceive that they are not safe from crime, for example, if they believe that criminals are likely to victimize them. As the perceived level of crime increases, fewer recreational bicyclists will ride on a facility.

The expected relationship is shown graphically in Figure 2-24.

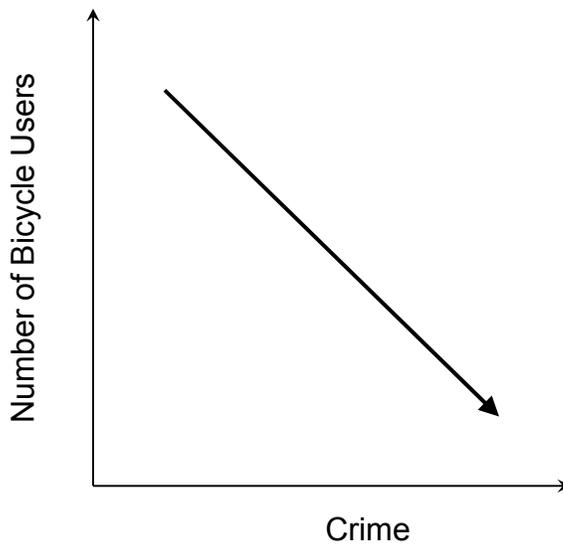


Figure 2-24 Number of bicycle users by crime

Scenery/Aesthetics Recreational bicyclists want to ride in attractive environments that are quiet and interesting. They do not want to ride in ugly environments that are noisy and dull. The scenic and aesthetic attributes of the environment contribute to their perceptions of the facility. For example, a recreational bicyclist would likely consider a shared use path next to a pristine lake to be beautiful, quiet, and appealing. On the other hand, if all the bicyclist sees are monotonous buildings, he or she would likely consider the environment as unattractive and uninteresting. Thus, the former will attract many more recreational bicyclists than the latter. The number of recreational bicyclists on a facility increases as the scenic and aesthetic qualities increase.

Figure 2-25 shows that as the scenery and aesthetics increase, so does the number of recreational riders.

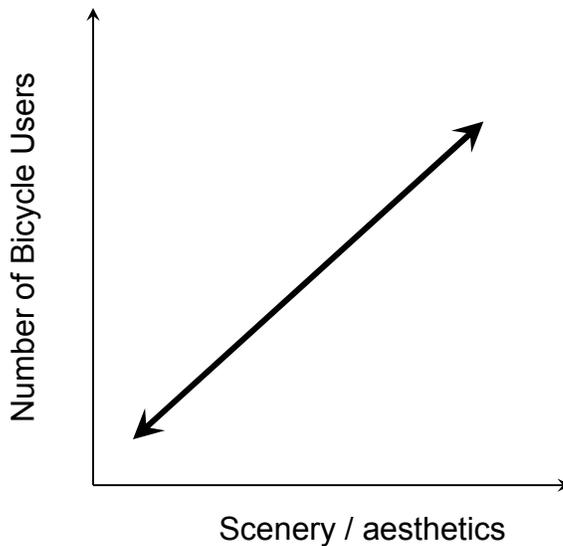


Figure 2-25 Number of bicycle users by scenery and aesthetics

Distance-Weighted Population A bicyclist is more likely to use a facility if he or she lives close to that facility than if he or she lives farther away from it. Thus, other factors being equal, a facility in an urban area is likely to have more users (because more people live close to it) than a facility in a rural area (because fewer people live close to it).

As defined in the section on “Induced Recreational Trips Model Development,” the distance-weighted population is a measure of how many people there are within a given distance of a facility, with more weight being given to people who live closer to a facility.

Figure 2-26 shows that the higher the distance-weighted population, the more facility users are expected.

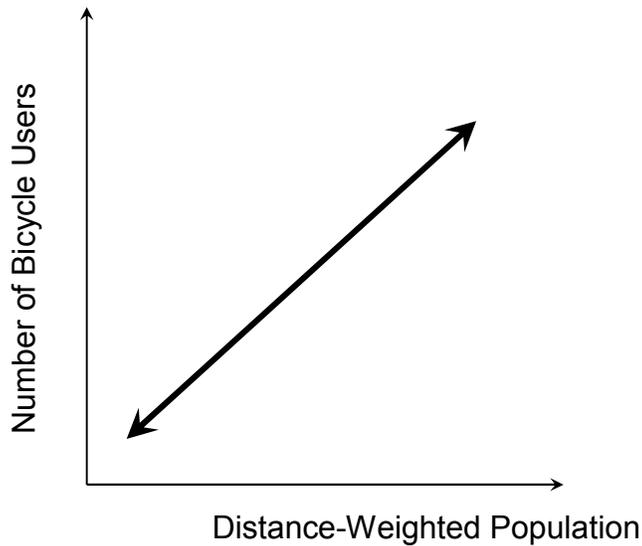


Figure 2-26 Number of bicycle users by distance-weighted population

Bicycle LOS Recreational bicyclists want to ride on facilities where they feel that their needs as bicyclists are being accommodated. The bicycle LOS is a measure of how well bicyclists are accommodated on roadways. Improvements in bicycling conditions, such as adding bicycle lanes, increase the level of accommodation and therefore improve the bicycle LOS.

Figure 2-27 shows the expected relationship between bicycle LOS and the number of bicyclists.

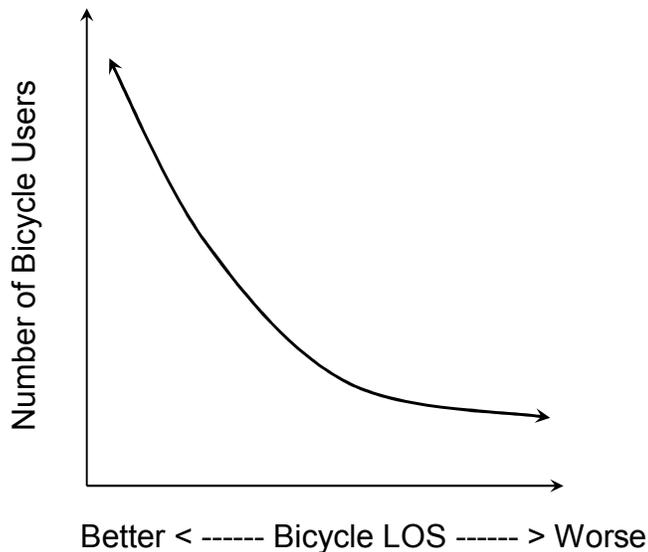


Figure 2-27 Number of bicycle users by bicycle LOS

Data Collection

Data collection consisted of three components: intercept surveys, in-office data (Census data and map reviews), field data (windshield surveys and detailed multi-modal level of service data).

The intercept surveys were conducted along each corridor and included questions about the specific trip being taken (trip length, trip purpose) and respondent demographics. Census data and map reviews were used to obtain data on population and employment. Field data collection resulted in the level of service and network friendliness information.

Preliminary (Phase I Study) Results

The “before” data collected on these corridors were used to develop the models that measure potential induced recreational bicycling as a result of investing in new bicycle facilities. A discussion of the model development process and model terms follows.

Induced Recreational Trips Model Development

SPSS (Statistical Package for the Social Sciences) software was used to model the number of recreational trips as a function of the characteristics mentioned above. The original data set consisted of the initial FDOT District 7 corridors and the Conserve by Bicycle corridors and had a sample size of 17 corridors. To increase the sample size, the original data set was supplemented with corridors that were included in the FDOT District 1 study on “Sidepath Facility Selection and Design,”⁴⁰ and several other corridors. For these supplemental corridors, the researchers created network analysis zones according to estimated trip length and hypothetical data collection locations, and then obtained Census data for population density, employment density, age, and income.

The final data set used to develop the induced recreational trips model contained 42 corridors. Table 2-10 lists the characteristics of the supplemental corridors.

⁴⁰ Landis, Bruce, *et al.* *Sidepath Facility Selection and Design*. Prepared for Florida Department of Transportation, May 2005.

http://www.dot.state.fl.us/safety/ped_bike/brochures/pdf/Sidepath%20facility%20selection%20&%20design.pdf

Table 2-10 Supplemental Study Corridors (Shared Use Paths Adjacent to Roadways)

ID	Name	From	To	Location	Number of Bicyclists¹	Length of Facility (mi)	Width of Facility (ft)
18	Suncoast Parkway	Alderman-Turner Rd	US 98	Hillsborough, Pasco, and Hernando Counties	29	41.429	10
19	US 98	Chase St	Olive Rd	Santa Rosa County	14	7.281	10
20	St. Marks Trail	Wakulla County Line	Gaile Ave	Leon County	19	8.972	10
21	SR674	E of Cypress Creek Crossing	US 301	Hillsborough County	6	2.015	10
22	66 th St at 71 st Ave			Pinellas County	19	0.5	10
23	66 th St at 114 th Ave			Pinellas County	34	0.4	10
24	SR 54			Pasco County	8	3.630	10
25	SR 84	Markham Park	University Dr	Broward County	3	12.386	10
26	Six Mile Cypress Parkway	US 41	Metro Parkway	Lee County	10	1.156	10
27	A1A	Indian River County Line	Oak St	Brevard County	16	14.287	10

ID	Name	From	To	Location	Number of Bicyclists¹	Length of Facility (mi)	Width of Facility (ft)
28	A1A	Broward County Line	US 1	Palm Beach County	14	25.506	10
29	A1A	CR 203	Duval County	St. Johns County	5	7.151	10
30	A1A	Martin County Line	Indian River County Line	St. Lucie County	18	17.945	10
31	SR 24	US 41/US 27	SW 85 th Ave/SW 75 th St	Alachua County	8	7.381	10
32	Black Creek Trail	Jacksonville City Limit	Doctors Inlet	Clay County	11	7.620	10
33	SR 582			Hillsborough County	20	2.1	10
34	SR 574			Hillsborough County	9	0.9	10
35	M Path	SW 67 th Ave	SR 9A	Miami-Dade County	18	8.226	10
36	SR 688			Largo	19	0.2	10
37	Missouri Ave			Largo	20	3.0	10
38	US 92			Tampa	20	0.7	10

ID	Name	From	To	Location	Number of Bicyclists¹	Length of Facility (mi)	Width of Facility (ft)
39	St. Marks Trail	St. Marks	Tallahassee		19	27.0	10
40	SR 54				8	3.630	10
41	Pinellas Trail			St. Petersburg	8	34	10
42	Suncoast Parkway	Pasco County Line	US 50	Hernando County	22	44	10

¹ The researchers obtained three-hour bicycle counts for each corridor, generally from 3 PM to 6 PM on a Tuesday, Wednesday, or Thursday.

Final Induced Recreational Trips Model

Numerous combinations of independent variables and independent variable transformations were tested. The final model and its terms are shown below:

$$\text{RecEstPos} = -0.020 + 0.625 \cdot \text{AESxINT} + 11.183 \cdot \text{SigmInvBLOS} + (5.46 \times 10^{-5}) \cdot \text{Pop}_{10}$$

(Eq. 2-16)

where

RecEstPos	= Estimated number of recreational trips from 3 PM to 6 PM
AESxINT	= Aesthetics multiplied by points of interest
SigmInvBLOS	= Sigmoid of the facility length multiplied by the inverse of the positive effective bicycle LOS
Pop ₁₀	= Distance-weighted population
r ²	= 0.405

More detailed descriptions of the variables in the model follow.

RecEstPos (Estimated number of recreational trips from 3 PM to 6 PM) – The researchers obtained three-hour bicycle counts for each corridor, generally from 3 PM to 6 PM on a Tuesday, Wednesday, or Thursday. According to the researchers’ knowledge of the corridors and trip purposes stated on returned surveys, they then estimated the number of recreational bicyclists as 10, 40, or 90 percent of the total number of bicyclists counted. For example, an estimated 90 percent of the bicyclists on the Pinellas Trail are recreational. On the other hand, based on the researchers’ knowledge of the area, most bicyclists on Nebraska Avenue are making utilitarian trips, so the amount of recreational trips was estimated to be 10 percent. The estimated number of recreational bicyclists on some corridors was negligible. Some potential variable transformations (such as logarithmic) are not applicable when the variable has a value of zero, consequently a value of 0.01 was substituted for zero values in those cases. Hence, the estimated number of recreational trips is always a positive number.

SigmInvBLOS (Sigmoid of the facility length multiplied by the positive effective bicycle

LOS) – This variable incorporates facility length. Figure 2-20 shows that the expected relationship between the number of recreational bicyclists and the length of the facility follows a sigmoid (S-shaped) curve. The sigmoid of the facility length is calculated as

$$P(L) = \frac{1}{1 + e^{-(L-9)}} \quad (\text{Eq. 2-17})$$

where

P(L) = Sigmoid of the length

L = Facility length, in miles

The positive effective bicycle LOS took on these values:

1. 0.50 for an existing independent alignment
2. 0.75 to 2.00 for an existing shared use path adjacent to roadway, according to the distance from the roadway
3. calculated segment bicycle LOS + 2.00 for a corridor with existing bicycle lanes or with no bicycle facilities

The researchers took the inverse of the positive effective bicycle LOS because an improvement in the bicycle LOS has more effect on the number of riders when the existing bicycle LOS is already very good (for example, an improvement from 2 to 1) than when the existing bicycle LOS is poor (for example, an improvement from 6 to 5). The expected relationship is shown graphically in Figure 2-28.

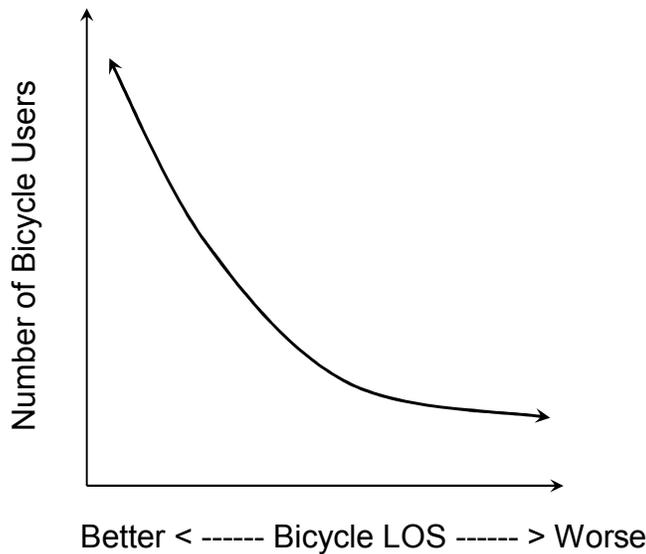


Figure 2-28 Number of bicycle users by bicycle LOS

The researchers expected that SigmInvBLOS would have a positive coefficient because:

1. The number of recreational bicyclists is thought to increase with greater facility length (Figure 2-20); and
2. The number of recreational bicyclists is thought to increase with better bicycle LOS, which translates into a higher value of inverse bicycle LOS.

Initially, models with separate terms for length and positive effective bicycle LOS were tested. It was found that the model coefficients were affected by the Pinellas Trail, where there were an estimated 83 recreational bicyclists in a 3-hour period. This count was much higher than that of other facilities having a similar length and similar positive effective bicycle LOS. By combining these two terms the correlations were improved.

AESxINT (aesthetics multiplied by points of interest) – This variable includes amenities/points of interest (Figure 2-22) and scenery/aesthetics (Figure 2-25). It is also a surrogate for crime (Figure 2-24) in that areas perceived as having more criminal activity often have little in the way of aesthetics. Each corridor received a score of 1 (lowest), 2, 3, 4, or 5 (highest) for aesthetics. Each corridor also received a score of 1 (lowest), 2, or 3 (highest) for

points of interest. The scores were generalized and were not based on counts of specific aesthetic features or points of interest. It was expected that this variable would have a positive coefficient because bicyclists prefer riding in visually appealing environments with points of interest (Figures 2-22 and 2-25).

Pop_10 - The distance-weighted population, Pop_10, is calculated by

1. Identifying all Census tracts whose centroids were within 10 miles of the actual or hypothetical survey location;
2. Dividing the population of each Census tract by the square of the distance between that Census tract and the survey location (individuals living near a bicycle facility are more likely to use it than those living farther away from the facility); and
3. Summing the “Pop_10” values across all Census tracts.

Mathematically, the equation is written as

$$Pop_10 = \sum_{i=1}^n \frac{pop_i}{d_i^2} \quad (\text{Eq. 2-18})$$

where

pop_i = Population of the i-th Census tract

d_i² = Distance (in miles) of the i-th Census tract from the survey location, squared

n = Total number of Census tracts whose centroids are within a specified distance (in this case, 10 miles) of the survey location

Figure 2-29 below shows a cut line (represented by a black circle) surrounded by numerous Census tracts that are within 10 miles. Census Tracts 1, 2, and 3 are highlighted in blue. These tracts are located at distance d₁, d₂, and d₃ from the cut line. The population of Tract 1 is divided by the square of its distance from the cut line to obtain a distance-weighted population for Tract 1. The process is repeated for Tracts 2, 3, etc., until distance-weighted populations have been obtained for all of the tracts. The distance-weighted populations are then added together to obtain the distance-weighted population within 10 miles.

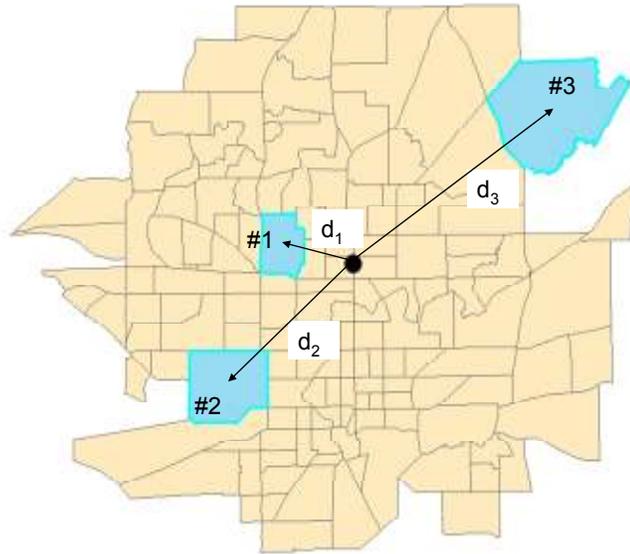


Figure 2-29 Distance from cut line to Census tracts

The researchers calculated distance-weighted populations for distances of 5, 10, 15, 20, 25, 30, 35, and 40 miles (Pop_5, Pop_10, Pop_15, etc.). Pop_10 was more nearly statistically significant than Pop_5. There were virtually no changes in the levels of significance with Pop_15 and greater distances, so the final model contains the population proximity within 10 miles, Pop_10.

The researchers expected that distance-weighted population would have a positive coefficient because a facility is more likely to be used if potential bicyclists live nearby.

Induced Recreational Model Summary

A summary of the coefficients (B), t statistics (t), and p-values (Sig.) appears in Table 2-11 below.

Table 2-11 Induced Recreational Trips Model

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta	B	Std. Error
1	(Constant)	.020	4.156		.005	.996
	AESxINT	.625	1.004	.118	.623	.538
	SIGMxINVBLOS	11.183	3.803	.558	2.940	.006
	POP_10	5.46E-005	.000	.164	1.228	.228

Table 2-12 shows the values of the variables in each corridor. ID #1 through #17 are the original 17 corridors.

Table 2-12 Values of Variables in Each Corridor

ID	CORRIDOR	Pop_10	RECESTPOS	AESxINT	SIGMx INVBLOS
1	16th St S	21,260.60	4.00	3	0.000
2	31st St N	78,997.50	3.00	2	0.006
3	Bruce B Downs / Commerce Palms	13,441.63	4.00	2	0.006
4	Bruce B Downs / SR 56	6,946.36	0.01	2	0.019
5	CR 550	10,627.64	1.00	3	0.000
6	Elgin	114,178.77	0.01	2	0.004
7	Lutz-Lake Fern	15,798.84	0.01	3	0.023
8	Nebraska	79,663.32	4.00	1	0.090
9	SR 60	43,858.36	2.00	1	0.130
10	US Alt 19	76,177.21	83.00	9	2.000
11	20th St	36,924.75	3.00	1	0.000
12	M Path	129,804.35	4.00	3	0.256
13	Sunrise Blvd	96,244.65	0.01	2	0.000
14	Spring to Spring	17,631.29	3.00	4	0.001
15	St Marks	406.82	14.00	8	2.000
16	Upper Tampa Bay (Sheldon Rd)	37,367.52	11.00	8	0.538
17	West Orange Trail (Clarcona Rd)	Not available	14.00	8	2.000

ID	CORRIDOR	Pop_10	RECESTPOS	AESxINT	SIGMx INVBLOS
18	Sun Coast Parkway	24,358.98	26.00	8	1.070
19	US 98 (Santa Rosa County)	4,809.22	6.00	3	0.430
20	St. Marks Trail	406.82	17.00	3	1.208
21	SR 674 (Sun City Center, Hillsborough County)	6,989.63	5.00	2	0.009
22	66th St at 71st	61,200.36	8.00	2	0.002
23	66th St at 114th	51,996.51	14.00	2	0.002
24	SR 54	Not available	3.00	3	0.043
25	SR 84 2 (Broward County)	49,839.31	1.00	2	0.639
26	Six Mile Cypress Parkway (Lee County)	23,128.52	9.00	1	0.004
27	A1A Brevard	9,592.19	6.00	8	0.550
28	A1A Palm Beach	31,406.66	6.00	8	0.610
29	A1A St. Johns	25,656.07	2.00	6	0.380
30	A1A St. Lucie	132,400.30	7.00	6	0.760
31	SR 24 (Alachua County)	3,392.27	3.00	2	0.432
32	Black Creek Trail (US 17, Clay County)	14,858.07	10.00	6	0.893
33	SR 582 (Fowler, Hillsborough County)	109,603.58	8.00	2	0.010
34	SR 574 (MLK Blvd, Hillsborough County)	36,107.21	4.00	2	0.003
35	M Path (US 1, Miami-Dade County)	129,804.35	7.00	3	0.731
36	SR 688 (Ulmerton Rd, Largo)	66,722.04	8.00	2	0.002
37	Alt US 19 (Missouri Ave, Largo)	94,345.36	8.00	2	0.024
38	US 92 (N Dale Mabry, Tampa)	54,930.75	8.00	4	0.002
39	St. Marks Trail	406.82	17.00	4	1.270
40	SR 54	Not available	3.00	2	0.006
41	Pinellas Trail in St. Pete	Not available	7.00	3	2.000
42	Suncoast Trail Pasco to SR 50	24,358.98	21.00	7	2.000

Variables Not Included in the Final Model

Other variables were theoretically important but were not included in the Study's Phase I induced recreational trips model for various reasons. These are described in the following paragraphs:

Intersections and Interruptions – The researchers tested various measures of intersections and interruptions (Figure 2-13) (including signals per mile; unsignalized intersections per mile; driveways per mile; and unsignalized intersections per mile plus driveways per mile). There were only weak Pearson correlations⁴¹ between these variables and the dependent variable (number of recreational trips).

Number of Other Trail Users – The number of other trail users (Figure 2-15) is theoretically important but it is not possible to confirm the importance of this variable on induced demand without a specific study targeting this variable. The number of users observed on the corridors was not high enough for this to be a factor.

Example Induced Recreation Calculation

To estimate the health benefits of providing bicycle facilities, it is necessary to estimate the number of bicyclists that result when a facility is provided. Some bicyclists will have switched modes from the automobile; an example calculation of the estimated mode shift is given above. Other bicyclists will be induced recreational bicyclists; an example calculation is given below.

This example calculation uses the recommended model on Corridor #8, Nebraska Avenue, in Tampa. Nebraska Avenue is a four-lane urban arterial. The cross-section is a mix of four-lane divided and four-lane undivided. The surrounding land uses are a mix of commercial and residential at fairly moderate to high densities in terms of Florida metropolitan areas. The input variable values are shown in Table 2-13.

⁴¹ The Pearson correlation, r , is a measure of the linear relationship between two variables. The value ranges from -1 (perfect negative correlation) to +1 (perfect positive correlation). A value of 0 means that there is no linear relationship between the two variables.

Table 2-13 Input Variable Values, Nebraska Avenue, Tampa

Type of Bicycle Facility	Baseline – Shared Use Lane	Bicycle Lane or Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Effective Bicycle LOS	6.85	5.83	2.00	0.50

	Common Values
Aesthetics	1
Points of Interest	1
Facility Length	9.4
Distance-Weighted Population	79,663

The recommended model for induced recreational trips (Equation 2-16) is repeated here for convenience:

$$\text{RecEstPos} = -0.020 + 0.625 * \text{AESxINT} + 11.183 * \text{SigmInvBLOS} + (5.46 \times 10^{-5}) * \text{Pop}_{10} \quad (\text{Eq. 2-16})$$

where

- RecEstPos = Estimated positive number of recreational trips from 3 PM to 6 PM
- AESxINT = Aesthetics multiplied by points of interest
- SigmInvBLOS = Sigmoid of the facility length multiplied by the inverse of the positive effective bicycle LOS
- Pop₁₀ = Distance-weighted population
- r² = 0.405

Substituting the values from the “Existing Condition” column into the model results in:

$$\text{RecEstPos} = -0.020 + 0.625 * 1 * 1 + 11.183 * 0.087 + (5.46 \times 10^{-5}) * 79,663 \quad (\text{Eq. 2-19})$$

With a facility length of 9.4, the sigmoid of the facility length is 0.599. With a positive effective bicycle LOS of 6.85, the inverse is 0.146. The product of 0.599 and 0.146 is 0.087.

The predicted number of recreational trips for 3 PM to 6 PM is 6. By applying the model to the other conditions (bicycle lane/paved shoulder, shared use path adjacent to roadway, and

independent alignment), the predicted number of recreational bicycle trips for 3 PM to 6 PM is shown in the middle row of Table 2-14.

Table 2-14 Predicted Number of Recreational Bicycle Trips by Facility Type, Nebraska Avenue Corridor, Tampa

Condition	Baseline – Shared Use Lane	Bicycle Lane or Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Trips (3 PM to 6 PM)	6 ¹	6	8	18
Trips (daily)	24	25	33	74

¹ The reader is advised that the numbers shown in the table have been rounded to the nearest whole number.

The 3 PM to 6 PM time period accounts for 25 percent of daily bicycle trips.⁴² The daily bicycle trips are shown in the bottom row of the table.

Example Health Benefit Calculation

Using the above predictive methodology one can calculate the health benefits in dollars that will occur if a given bicycle facility is provided. In the above example, the number of induced recreational cyclists that would use a corridor if a given facility type were provided was calculated. In the discussion following Table 2-14, the number of additional utilitarian cyclists was calculated. Since both recreational and utilitarian bicyclists will reap health benefits, both are included in the calculation of health benefits.

The following key pieces of information are to calculate the health benefits shown in Table 2-15.

- average utilitarian trip length = 3 miles⁴³
- average recreational trip length = 5 miles⁴⁴

⁴² Jones, Michael and Lauren Buckland. National Bicycle & Pedestrian Documentation Project. Presentation given to the Transportation Research Board, January 2006.

⁴³ CUTR. *Bicycle and Pedestrian Travel: Exploration of Collision Exposure in Florida*. University of South Florida, Tampa, FL, 2002.

- an individual rides on the facility 50 times a year⁴⁵
- health benefit = 49 cents per trip (The health benefit of \$128 per person per year assumes that a person is physically active 5 times a week, or 260 times a year⁴⁶. The benefit per trip is $\$128/260 = 49$ cents. The benefit is not pro-rated according to distance ridden.)

It must be kept in mind that both the mode shift model and the induced recreational demand model were developed to predict the number of users through a point on the facility. The predicted total number of users (and consequently the benefits) were then extrapolated in proportion to the length of the facility to obtain the overall benefit of providing the new facility. For example the number of users shown in Table 2-14 above would then be multiplied by the facility length divided by the average trip length to obtain the total number of users on the facility. These user numbers are then used to calculate the benefits (relative to the baseline condition) shown in Table 2-15:

⁴⁴ CUTR. *Bicycle and Pedestrian Travel: Exploration of Collision Exposure in Florida*. University of South Florida, Tampa, FL, 2002.

⁴⁵ Moore, Roger L., Alan R. Graefe, Richard J. Gitelson, and Elizabeth Porter. *The Impacts of Rail-Trails: A Study of the Users and Property Owners from Three Trails*. National Park Service, Washington, DC, February 1992.

⁴⁶ Krizek, Kevin, *et al.* *Guidelines for Analysis of Investments in Bicycle Facilities*. National Cooperative Highway Research Program Report 552. Transportation Research Board, Washington, DC, 2006.

Table 2-15 Health Benefits per Year, Nebraska Avenue Corridor, Tampa

	Baseline – Shared Use Lane	Bicycle Lane or Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Number of Utilitarian Cyclist Trips per Year	9,068	20,037	370,882	1,240,762
Number of Recreational Cyclist Trips per Year	16,019	16,478	22,377	49,316
Health Benefit per Year		\$5,626	\$181,254	\$622,765

The above health benefits are for one example location. The predicted health benefits would vary depending upon the specific characteristics of the study roadway corridor and surrounding area. Two more examples are provided below, so that the reader can see how the predicted health benefits vary from one corridor to another.

The second example shows the predicted health benefits for Corridor #15, the St. Marks Trail, between Tallahassee and Wakulla. The St. Marks Trail is parallel to Woodville Highway, a two-lane rural arterial. Table 2-16 shows input values for the St. Marks Trail.

Table 2-16 Input Variable Values, St. Marks Trail Corridor, Tallahassee

Type of Bicycle Facility	Baseline – Shared Use Lane	Bicycle Lane or Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Effective Bicycle LOS	7.78	6.08	2	0.5

	Common Values
Aesthetics	4
Points of Interest	2
Facility Length	27
Distance-Weighted Population	407

The resulting health benefits (relative to the baseline condition) are shown in Table 2-17.

Table 2-17 Health Benefits per Year, St. Marks Trail Corridor, Tallahassee

	Baseline - Shared Use Lane	Bicycle Lane/Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Number of Utilitarian Cyclist Trips per Year	5	22	793	27,044
Number of Recreational Cyclist Trips per Year	20,791	22,080	34,119	87,942
Health Benefit per Year		\$643	\$6,950	\$46,371

The third example shows the predicted health benefits for Corridor #12, the M Path, in Miami. The M Path runs generally parallel to US 1, a six-lane divided urban arterial roadway. The Metrorail rapid transit route, operated by Miami-Dade Transit, uses elevated tracks adjacent to, and at some locations, directly above, the M Path. Table 2-18 shows input values for the M Path.

Table 2-18 Input Variable Values, M Path Corridor, Miami

Type of Bicycle Facility	Baseline – Shared Use Lane	Bicycle Lane or Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Effective Bicycle LOS	8.33	7.28	1.24	0.5

	Common Values
Aesthetics	3
Points of Interest	1
Facility Length	8.226
Distance-Weighted Population	129,804

The resulting health benefits (relative to the baseline condition) are shown in Table 2-19.

Table 2-19 Health Benefits per Year, M Path Corridor, Miami

	Baseline – Shared Use Lane	Bicycle Lane/Paved Shoulder	Shared Use Path Adjacent to Roadway	Independent Alignment
Number of Utilitarian Cyclist Trips per Year	6,337	14,317	1,232,728	2,074,560
Number of Recreational Cyclist Trips per Year	20,191	20,322	25,391	34,434
Health Benefit per Year		\$3,993	\$606,322	\$1,025,214

A summary of the potential health benefits for all the study corridors is in Appendix M.

The model described above provides reasonable predictions for the level of induced recreational bicycling that will result from providing or improving facilities for bicyclists along a corridor. However, additional Phase II data should be collected after the programmed facilities are

installed. Additionally, data from more varied locations is needed. These data will result in improved accuracy of the model.

CHAPTER 3 SAFE ROUTES TO SCHOOL

This portion of the Conserve by Bicycle Phase I report evaluates the energy savings and health benefits of Safe Routes to School programs.

One of the goals of the Conserve by Bicycle Program Study is to determine:

- *How the Safe Paths to Schools Program and other similar programs can reduce school-related commuter traffic, which will result in energy and roadway savings as well as improve the health of children throughout the state.*

Measurable Criteria

The measurable criterion for evaluating Safe Routes to Schools programs is mode shift. A Safe Routes to Schools program results in energy savings and health benefits if the implementation of that program results in the outcome that a student who otherwise would have been driven to school in a car now chooses to ride a bicycle.

Literature Search

A literature search was conducted to evaluate Safe Routes to School programs in Florida and across the United States. The researchers were specifically looking for programs that could document a mode shift. Some of the findings of this literature search are described below. The complete literature search pertaining to Safe Routes to School programs is contained in Appendix Q of this report.

Only one study was found that documented mode shift and thereby met the needs of this study: an evaluation of the Safe Routes to Schools program in Marin County, California. That program resulted in the bicycle mode share increasing from 7% (at the beginning of the school year) to 9% (at the end of the school year).

Research Plan

To accurately quantify the effects of FDOT's Safe Routes to School (SRTS) programs, data would need to be collected during Phase II of this study on programs implemented in the State. In fact, local agencies that are selected by FDOT for funding are required to administer the student and parent surveys developed by the National Center for Safe Routes to School

(<http://www.saferoutesinfo.org/resources/index.cfm>). These surveys will provide before-and-after data on how students travel to school.

The student survey (Figure N-1 in Appendix N) will help measure how students get to school and whether the SRTS Program affects trips to and from school. Teachers can use this form to record specific information about how children arrive and depart from school each day for a week. The information this form helps collect will be used to help track the success of SRTS programs across the country. Unfortunately, these data will not be available until Phase II of this Conserve by Bike Program Study.

The parent survey (Figures N-2, N-3, and N-4 in Appendix N) asks for information about what factors affect whether parents allow their children to walk or bike to school, the presence of key safety-related conditions along routes to school, and related background information. The survey results will help determine how to improve opportunities for children to walk or bike to school, and measure parental attitude changes as local SRTS programs occur.

While National Center for Safe Routes to School surveys will provide useful information about mode shift, additional data collection would provide more insight into increases in cycling. For example, before-and-after counts of bicyclists in school zones would quantify total bicycling activity among students. Before-and-after vehicle counts at dropoff zones will answer the question, “How many students who are bicycling to school in the after period were driven to school in the before period?” The answer to that question is the mode shift from car to bicycle, from which energy savings and health benefits are calculated. Finally, in Phase II data may be collected on changes to school bus routes and schedules in the exclusion zone, as more students riding bicycles to school may mean that fewer school buses are needed.

Program Evaluations – Phase I of Study

To obtain information on the effectiveness of Safe Routes to School programs on mode shift, the researchers reviewed the following Safe Routes to School programs in Phase I:

1. Brevard County, FL, MPO
2. Florida DOT
3. Marin County, CA
4. Duval County, FL

These programs are intended to encourage students to ride bicycles or walk to school (instead of being driven to school by their parents). All provide students with information about bicycling safety. Florida DOT and Marin County include promotional activities and infrastructure improvements.

None of these programs provided data on energy savings and improved public health. However, Marin County California provided mode share data, from which energy savings and health benefits can be estimated as outlined previously in this report. Brevard County and Duval County provided bicycle counts. Florida DOT's Safe Routes to School is just getting underway, so no before or after data have been collected yet.

Marin County found that 7% of students rode bicycles to school in Fall 2004, and 9% of students rode bicycles to school in Spring 2005. It should be noted that Marin County's efforts do not exclusively target bicycling to the exclusion of other modes. Instead, the stated goal is "to increase the number of non-motorized (walk and bike) and higher occupancy (carpool and transit) trips to schools." In fact, the bike, walk, and carpool mode shares all increased:

- Bike Increased from 7% to 9%
- Walk Increased from 14% to 20%
- Carpool Increased from 17% to 22%
- Bus: Stayed the same at 7%
- Driven alone Decreased from 55% to 42%

This explains why the bicycling mode share did not increase more than it did. That the bicycling mode share did increase from 7% to 9% is an indication of the program's effectiveness.

Marin County also estimated that for the 2004-2005 school year, the Safe Routes to Schools Program reduced motor vehicle travel by nearly 2.6 million vehicle miles, due to fewer students being driven alone. The increase in bicycling reduced motor vehicle travel by about 350,000 vehicle miles; the remaining reductions resulted from increases in walking and carpooling. Using these data, the health benefits and energy savings can be calculated:

- \$23,000 in health benefits – The mode shift to bicycling represents 180 students riding their bicycles and being physically active, instead of being driven to school.
- \$53,000 in energy savings – This value assumes one gallon of gas, at \$3.00 per gallon, saved for every 20 vehicle miles not driven.

In Brevard County, FL, 6% to 7% of students ride their bicycles to school. The surveys were conducted in 2000, 2003, and 2006. The local Bicycle/Pedestrian Coordinator attributed the lack of an increase in the percentage of students riding bicycles to the bike helmet law (some children chose not to ride instead of having to wear a helmet) and possible differences in reporting (some teachers may not have completed the surveys correctly). It is likely that with surveys being administered every three years, the surveys are not directly measuring the effects of bicycle education programs conducted in one school year. The population of students surveyed each year is not the same, because many students graduate from or transfer out of the school system, while other students enter the school system.

The number of students who were observed riding their bicycles in Duval County, FL, declined from 1997 through 2004. The program manager attributed the decline to changes in data collection procedures - initially most of the observations were conducted at elementary schools, but several elementary schools were later dropped and replaced by middle schools. The change in data collection procedures followed a decision to put more program emphasis on middle schools, because many middle school students did not want to wear helmets while bicycling. Also, data collection focused on whether students were wearing helmets while bicycling, rather than the total number of students who ride bicycles to school.

FDOT Districts administer Safe Routes to School Program funds and award contracts to counties to implement infrastructure and non-infrastructure activities. The first program activities are expected to be undertaken in Districts 7, 5, and 2. These include bicycle and pedestrian safety education consisting of teacher training workshops and student education in Districts 5 and 7, and sidewalk construction in District 2. In some counties, FDOT Safe Routes to School funding supplements other funding sources, thereby allowing more Safe Routes to School activities to be carried out than would otherwise be possible.

Detailed program descriptions are provided below.

Brevard County MPO – Safe Routes to School

Program Type This program includes the following Conserve by Bicycle evaluation element:
Safe Routes to School

Location This program is being conducted in Brevard County, Florida.

Description (from http://www.brevardmpo.com/bike-ped-trails/Bike_Ped.htm)

The MPO is committed to enhancing bicycle and pedestrian safety and quality of life in Brevard County by providing opportunities for people of all ages to learn how to safely use bicycle and pedestrian facilities. The MPO has a full-time staff person dedicated to this program.

The program includes working cooperatively with the Brevard County School Board to conduct in-school programs and with the community to conduct bicycle rodeos and safety fairs. The MPO also works with community partners to provide bicycle helmets to children throughout the year.

This ongoing program will be expanded with funding from FDOT's Safe Route to School program (see section on FDOT Safe Routes to School Program).

Program Activities The Brevard County MPO is working with Brevard County Schools to conduct teacher training. Students receive bicycle safety education, using materials from the Florida Traffic and Bicycle Safety Education Program. In partnership with Safe Kids, students receive bike helmets.

Participants Teachers administered Student Travel Surveys to their students on September 27, 2000; April 23, 2003; and April 12, 2006. Teachers asked students to raise their hands according to which mode they used to arrive at school. The 2003 survey is shown in Figure N-4 in Appendix N.

In 2000, students were surveyed at 52 elementary schools, 14 middle schools, 2 junior/senior schools, and 10 high schools. The results revealed that 6.9 percent of students rode bicycles to school (Figure N-5 in Appendix N).

In 2003, teachers surveyed students at 56 elementary schools, 14 middle schools, 2 junior/senior schools, 10 high schools, and 8 other schools. They found that 6.0 percent of students rode bicycles to school (Figure 3-1). The Brevard County MPO's Bicycle/Pedestrian Coordinator, Ms. Barbara Meyer, attributed the lack of an increase in the percentage of students riding bicycles to school to the bike helmet law (some children chose not to ride instead of having to wear a helmet) and possible differences in reporting (some teachers may not have

completed the survey correctly). Among students who rode the school bus, 1.8 percent rode bicycles to get to the school bus stop.

In 2006, 6.0 percent of students rode bicycles to school (Figure 3-1). Among students who rode the school bus, 1.9 percent rode bicycles to get to the school bus stop.

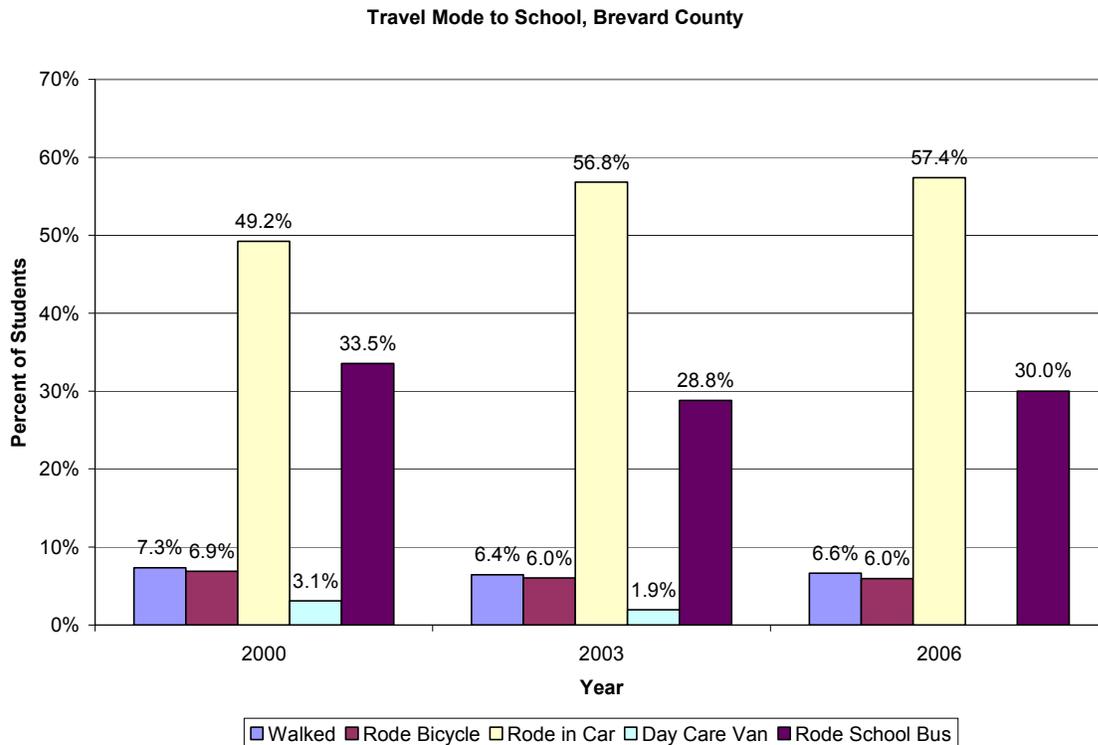


Figure 3-1 Travel mode to school

Additional Information More information on Brevard County’s Safe Routes to School Program can be obtained from the following sources:

- Barbara Meyer, Bicycle/Pedestrian Coordinator, Brevard County MPO, (321) 690-6890
- Kim Smith, Bicycle/Pedestrian Education Coordinator, Brevard County MPO, (321) 690-6890
- Brevard County MPO website, http://www.brevardmpo.com/bike-ped-trails/Bike_Ped.htm

FDOT Safe Routes to School Program

Program Type This program includes the following Conserve by Bicycle evaluation element:
Safe Routes to School

Location FDOT's Safe Routes to School Program is being conducted throughout the State of Florida.

Description (from http://www.dot.state.fl.us/safety/SRTS_files/SRTS.htm)

The Safe Routes to School Program (SRTS) was authorized in August 2005 by Section 1404 of SAFETEA-LU to make it safer, easier and more fun for children in grades K through 8, to walk or bicycle to and from school. The Florida Department of Transportation will be receiving approximately \$28.7 million for SRTS, through FY 2009. These funds will be administered through the seven FDOT Districts and overseen by the State Safe Routes to School Coordinator. Seventy to ninety percent of each District's SRTS funds will be dedicated to infrastructure (Engineering or construction) projects, with the remaining funds going toward noninfrastructure activities (Education, Encouragement, Enforcement, and Evaluation).

The purposes of the Safe Routes to School Program are:

- To enable and encourage children, including those with disabilities, to walk and bicycle to school,
- To make bicycling and walking to school a safer and more appealing transportation alternative, thereby encouraging a healthy and active lifestyle from an early age, and
- To facilitate the planning, development, and implementation of projects and activities that will improve safety and reduce traffic, fuel consumption, and air pollution in the vicinity of schools.

Program activities in FDOT Districts 2, 5, and 7 are described here.

Program Activities

District 2 District 2 is currently partnering with Shands Hospital and the local Community Traffic Safety Team to deliver bicycle and pedestrian education to students in all 18 counties of District 2.

SRTS funding will pay for the installation of sidewalks to connect three schools in Suwannee County. Figures N-6 and N-7 in Appendix N depict the conceptual layouts. A 15 MPH speed zone will also be established around the schools. These activities are scheduled to get underway in September 2007.

District 5 Brevard County will use SRTS funding to

- Purchase bicycle trailer, bicycles, helmets, and instructional materials,
- Allow 20 physical education teachers to attend training workshops, and
- Conduct Safe Routes to School community forums.

These activities will supplement existing SRTS-type activities (see Brevard County MPO – Safe Routes to School).

Lake and Sumter Counties will use SRTS funding to provide educational workshops for teachers, school administrators, and planners. Three workshops are anticipated: two at middle schools in Lake County and one at a middle school in Sumter County.

Volusia and Flagler Counties will use SRTS funding to offer bicycle and pedestrian safety teacher training workshops to fifteen elementary school teachers. The training will be conducted by the Florida Traffic and Bicycle Safety Education Program. SRTS funding will also be used to purchase bicycles, bicycle helmets, a cargo wagon to haul bicycles, and educational materials.

District 7 In District 7, SRTS funding will go towards non-infrastructure activities such as

- Walking School Bus or Bike Train for students,
- School incentive and encouragement programs,
- Bicycle rodeos,
- Pedestrian and bicycle safety education training for students, including paying for equipment and trainers, and
- Relevant training for teachers, school administrators, and parents, including paying for trainers and substitute teachers.

Additionally, FDOT District 7 will be purchasing school flashers and speed feedback signs for local jurisdictions to install. FDOT District 7 will also provide “Walk and Roll to

School” punch cards to students. After a student has walked or biked to school twenty times (and completed a punch card), he or she will receive a promotional item.

Participants Local agencies that are selected by FDOT for funding are required to administer the student and parent surveys developed by the National Center for Safe Routes to School (<http://www.saferoutesinfo.org/resources/index.cfm>). These surveys will provide before-and-after data on how students travel to school.

The student survey (Figure N-1 in Appendix N) will help measure how students get to school and whether the SRTS Program affects trips to and from school. Teachers can use this form to record specific information about how children arrive and depart from school each day for a week. The information that this form is used to collect will help agencies track the success of SRTS programs across the country.

The parent survey (Figures N-2, N-3, and N-4 in Appendix N) asks for information about what factors affect whether parents allow their children to walk or bike to school, the presence of key safety-related conditions along routes to school, and related background information. The survey results will help determine how to improve opportunities for children to walk or bike to school, and measure parental attitude changes as local SRTS programs occur.

Additional Information More information on FDOT’s Safe Routes to School Program can be obtained from the following sources:

Statewide

- Pat Pieratte, Safe Routes to School Statewide Coordinator, (850) 245-1529
- FDOT Safe Route to School website,
http://www.dot.state.fl.us/safety/SRTS_files/SRTS.htm

District 2

- Randy Warden, Pedestrian/Bicycle Coordinator, (904) 360-5631
- Holly Walker, Safety Engineer, (904) 360-5629

District 5

- Joan Carter, Pedestrian/Bicycle Coordinator, (386) 943-5335

District 7

- Jeanette Rouse, CTST Coordinator, (813) 975-6256
- Peter Hsu, Safety Program Engineer, (813) 975-6251

Marin County Safe Routes to School Program

Program Type This program includes the following Conserve by Bicycle evaluation element:
Safe Routes to School

Location This program is being conducted in Marin County, California.

Description Marin County's Safe Routes to Schools Program started in 2000. The program consists of encouragement, education, engineering, enforcement, and evaluation. The goal is to increase the number of walk and bike trips and higher occupancy (carpool and transit) trips to schools in order to:

- Reduce traffic congestion around schools,
- Increase physical activity for children and youth,
- Foster a healthier lifestyle for the whole family,
- Create safer, calmer streets and neighborhoods, and
- Improve air quality and a cleaner environment.

In the 2005-2006 school year, 45 schools with 18,477 students participated. This represents an increase from 2004-2005, when 37 schools with 16,261 students participated.

The Safe Routes to Schools Program was initially developed in 2000 by the non-profit Marin County Bicycle Coalition with funding from the National Highway Traffic Safety Administration. In January 2004, Marin County's Department of Public Works took over the program, and the Bay Area Air Quality Management District provided grant funding. The program is now administered by the Transportation Authority of Marin, with ongoing funding from a half-cent sales tax increase passed by voters in November 2004.

Over 20 years, this tax increase is expected to generate nearly \$11,000,000 for the Safe Routes to Schools Program. The tax increase also includes money for complementary activities: over \$11,000,000 to pay for infrastructure improvements and for “local match” funding required to leverage state and federal capital funding. Nearly \$14,000,000 will go to establishing a new school crossing guard program.

Program Activities (from http://www.tam.ca.gov/Uploads//2005-06%20SR2S%20Evaluation_Formatted_LowRes1.pdf)

Education Classroom lessons teach children the skills necessary to navigate through busy streets and show them how to be active participants in the program. A Safe Routes instructor developed the curriculum that includes lessons on safety, health, and the environment. Lessons are typically offered during the physical education period of the school day.

Engineering The Program’s licensed traffic engineer assists schools in developing a plan to provide a safer environment for children to walk and bike to school. The focus is on creating physical improvements to the infrastructure surrounding the school, reducing speeds and establishing safer crosswalks and pathways.

The Safe Routes to Schools Program assists cities and towns in Marin County with developing and submitting grant requests for Caltrans Safe Routes capital improvement projects. In fact, since the Safe Routes to Schools Program started, cities and towns have received nearly \$2,000,000 in Caltrans grants.

Encouragement Events, contests and promotional materials are incentives that encourage children and parents to try walking and biking. The program supports and coordinates volunteer organizers and provides schools with promotional and contest materials, prizes, and ongoing consultation.

Enforcement Police officers, crossing guards and other law enforcement officials participate throughout the Safe Routes process to encourage safe travel through the community. Targeted enforcement of speed limits and other traffic laws around schools makes the trip to school more

predictable for students and allows them to interact with motorists and other travelers in the safest possible way. This plan also includes enforcement enhancements and outreach to drivers through driver safety campaigns.

Evaluation Program participation is regularly monitored to determine the growth in student and parent participation. Typically, “before-and-after” surveys are taken to ascertain any change in travel mode to school over the course of the year. This year a parent survey was administered instead to obtain parent input on the program and reasons why they do or do not participate.

New Program Elements The following new elements were implemented in 2005-2006:

- On the Bike Middle School Program – At three middle schools, bicycle skills and safety training was incorporated into the physical education curricula.
- Yikes 2 Assembly: The Unsafe Helmet Fashion Show – Students learned about the importance of wearing a helmet and how to wear and fit a helmet for maximum safety and comfort.
- Rolling Along: Real Stories, Real People, Real Change – An alumna spoke to high school students about how she became a champion cyclist by biking to school.
- Redwood High School Buy Local Bike Local Day – The Safe Routes to School Education Coordinator worked with two interns for six months to create a traffic reduction campaign for Redwood High School and help them plan for a bike to school day on May 18th.
- Miller Creek Super Duper Walking/Biking Extravaganza – Students were rewarded on a random basis for bicycling or walking to school.

Partnerships (http://tam.ca.gov/Uploads/pdfs/SR2S_Program%20Evaluation.pdf)

Safe Routes to Schools often partners with other organizations in order to provide context for environmental and health related topics, as well as to enrich and diversify student, parent, and community involvement. Recent partnerships with SR2S include:

- **The School Environmental Education Docents (SEED)** – whose mission is to advance environmental education and awareness throughout local communities.
- **The Youth Leadership Institute (YLI)** - an organization that provides self-empowerment and leadership training for young people to maximize their involvement in the community.
- **The Next Generation of Activists** - a non-profit that educates, mobilizes, and inspires youth to initiate environmental and social changes on their campuses.
- **The Marin Conservation Corps (MCC)** – an organization dedicated to training youth and conserving Marin’s natural resources.
- **The YMCA** – providing education and resources to develop “Strong Kids, Strong Families, and Strong Communities.”
- **The Marin Physical Activity Nutrition Wellness Collaborative** – a collaborative of health and physical activity programs, coordinated by the Marin County Health and Human Services in order to promote better nutrition choices and a wider variety of physical activity options for Marin residents.

By fostering greater connections between the Safe Routes program and the youth and families of Marin, these partnerships are an important strategy for creating legitimate and lasting change within the County.

Participants A key element of the program is quantitative measurement of how students arrive at school – single student “chauffeured trips,” bicycle, walk, carpool, and transit – as the school year progresses. To measure this mode shift in the 2004-2005 school year, a Safe Routes to Schools staff member worked with the school administration to have teachers administer “before” and “after” surveys to determine how students travel to school. The “before” survey was administered at the beginning of the semester during which Safe Routes to School education is offered, and the “after” survey was administered at the end of the school year. In the 2005-2006 school year, surveys were administered to parents.

The results showed that 7% of students rode bicycles to school in Fall 2004, and 9% of students rode bicycles to school in Spring 2005. These results are from 26 schools with over 9,000 students; other schools were omitted because they started the Safe Routes to School program late, they did not collect both “before” and “after” data, or they had low survey response rates.

Figure 3-2 shows students’ travel modes to school for the 2004-2005 school year, and Figure 3-3, for the 2005-2006 school year. These charts show, for example, that the percentage of students who bike to school increased from 8% to 10%, and those who walk to school increased from 17% to 22%. It is likely that the changes are the result of the Safe Routes to School Program. The different data collection methodologies (surveys of students in 2004-2005 and surveys of parents in 2005-2006) may affect the results, but the extent of that effect, if any, is not known.

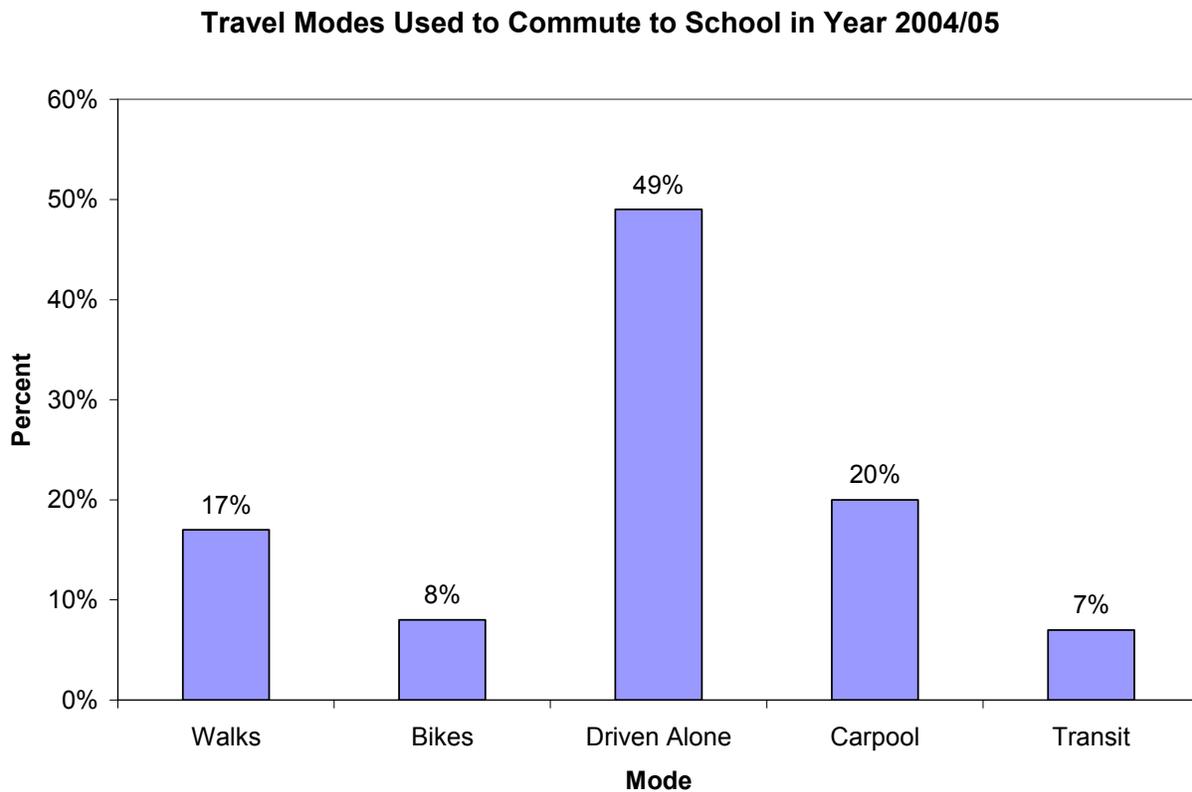


Figure 3-2 Students’ travel modes, 2004-2005
(Source: Transportation Authority of Marin)

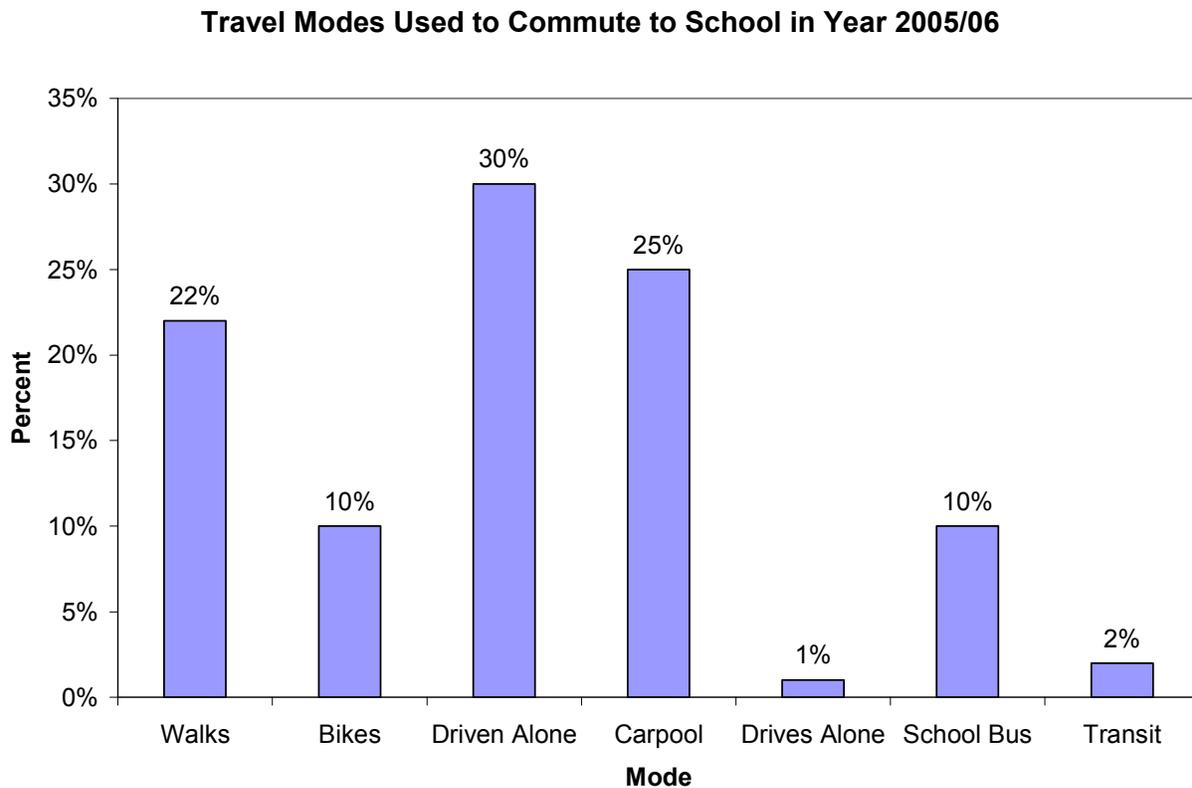


Figure 3-3 Students' travel modes, 2005-2006
(Source: Transportation Authority of Marin)

For the 2004-2005 school year, the Safe Routes to Schools Program reduced travel by nearly 2.6 million vehicle miles, due to fewer students being driven alone. Assuming 20 miles per gallon, the energy savings would be nearly 130,000 gallons of gas. As a result of the lower vehicle miles traveled, pollutant emissions were reduced by more than 10 tons and carbon dioxide emissions were reduced by almost 1,000 tons.

Nine percent of parents indicated switching from driving their children to school to having them walk or bike to school as a result of Safe Routes to Schools activities (Figure 3-4).

Change in Travel Behavior as a Result of Safe Routes to Schools

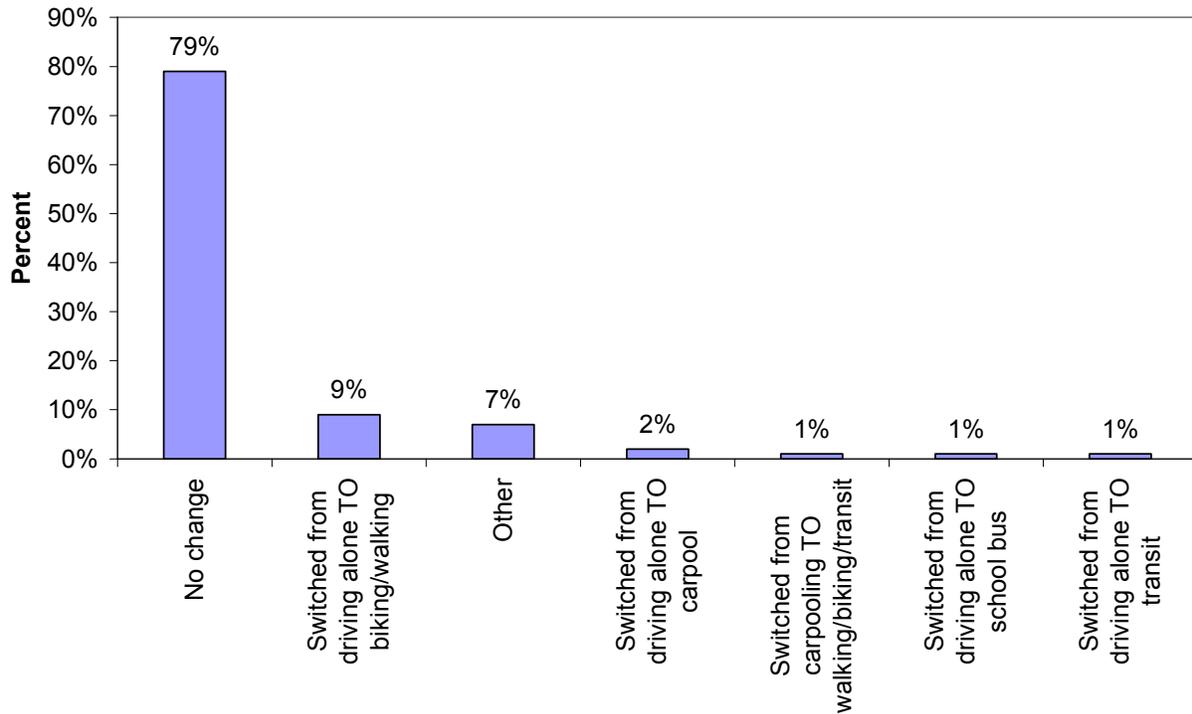


Figure 3-4 Changes in travel behavior as a result of Safe Routes to Schools
(Source: Transportation Authority of Marin)

Respondents were most likely to identify reduced congestion around schools as the greatest benefit of Safe Routes to School (Figure 3-5).

Greatest Value of Safe Routes to Schools Programs to Respondents

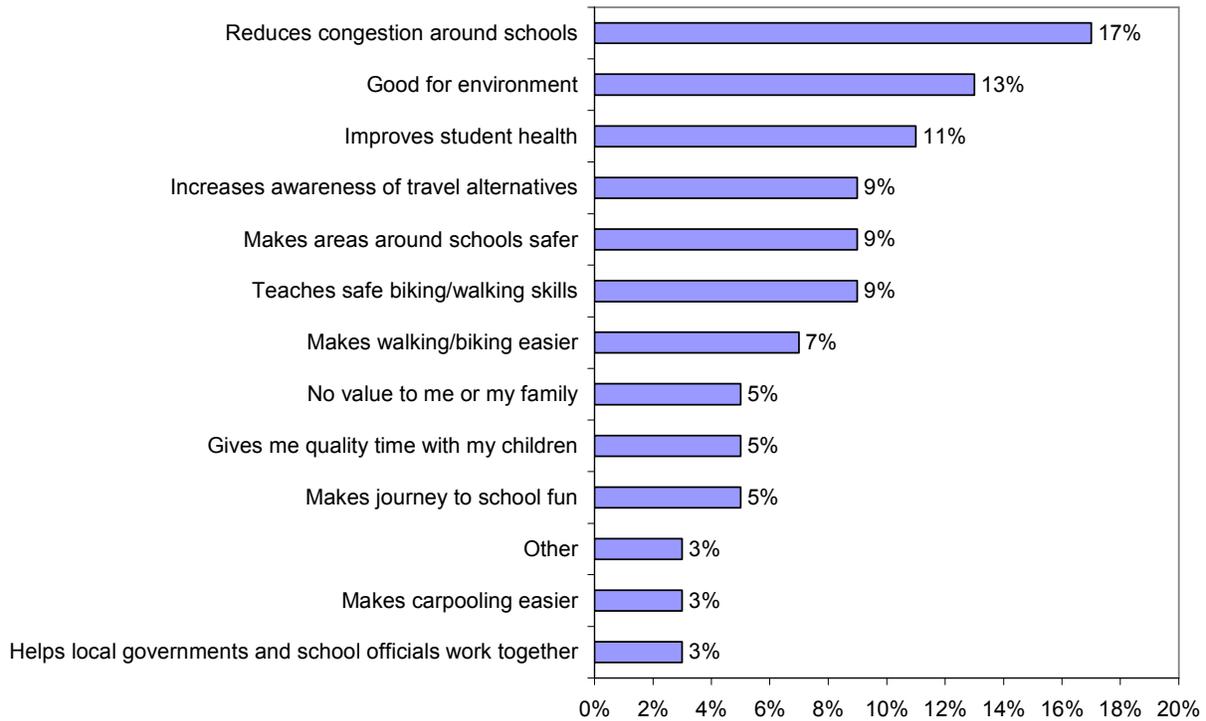


Figure 3-5 Greatest value of Safe Routes to Schools

(Source: Transportation Authority of Marin)

Additional Information More information about Marin County’s Safe Routes to Schools program can be obtained from the following sources:

- Nelson/Nygaard Consulting Associates. *Marin County Safe Routes to Schools Program Evaluation: 2004-2005*. August 2005. Available online at http://tam.ca.gov/Uploads/pdfs/SR2S_Program%20Evaluation.pdf
- Transportation Authority of Marin. *Marin County Safe Routes to Schools Program Evaluation and Recommendations 2005-2006*, December 2006. Available online at http://www.tam.ca.gov/Uploads//2005-06%20SR2S%20Evaluation_Formatted_LowRes1.pdf

Duval County, FL – Traffic, Bicycle and Pedestrian Education Program

Program Type Duval County's Traffic, Bicycle and Pedestrian Education Program included the following Conserve by Bicycle evaluation element:

Safe Routes to School

Location This program was conducted in Duval County, Florida.

Description From 1996-2005, the Duval County Health Department conducted a Traffic, Bicycle and Pedestrian Education Program that included teacher training, bicycling and walking skills training for students, and subsidized bike helmet sales to students. The program goal was to reduce the incidence of bicycle-related fatalities and injury severity within the target population of 5- to 14-year-old children in Duval County.

Program costs from 1995-2002 were \$976,000, and were funded largely by FDOT, Genesis Health Foundation, and the Centers for Disease Control.

Program Activities The bicycle safety education curriculum developed by FDOT was used in the Duval County Elementary Schools. Health Department staff and selected physical education teachers were trained by University of Florida staff. These trainers then trained other physical education teachers, who in turn instructed the students.

The Health Department purchased bicycle helmets and sold the helmets to school children at reduced prices.

The Health Department conducted annual surveys to determine bicycle helmet usage rates.

Participants From 1997 through 1999, bicycle helmet observations were conducted at 43 elementary schools, 3 middle schools, and 3 parks. Middle school students were then identified as a new target population, so from 2000 through 2004, bicycle helmet observations were conducted at 33 elementary schools, 12 middle schools, and 3 parks.

At schools, bicyclists were observed for one 30-minute period, either before classes started in the morning or after classes ended in the afternoon, but not both. In parks, bicyclists

were observed once on a weekday, once on a weekend morning, and once on a weekend afternoon.

Figure 3-6 shows the number of bicyclists observed. The program manager attributed the decline in the number to changes in data collection procedures (see above). It should also be noted that the counts were conducted primarily to assess helmet usage; only selected locations around schools were observed, so changes in students' travel patterns may have contributed to fluctuations in the number observed.

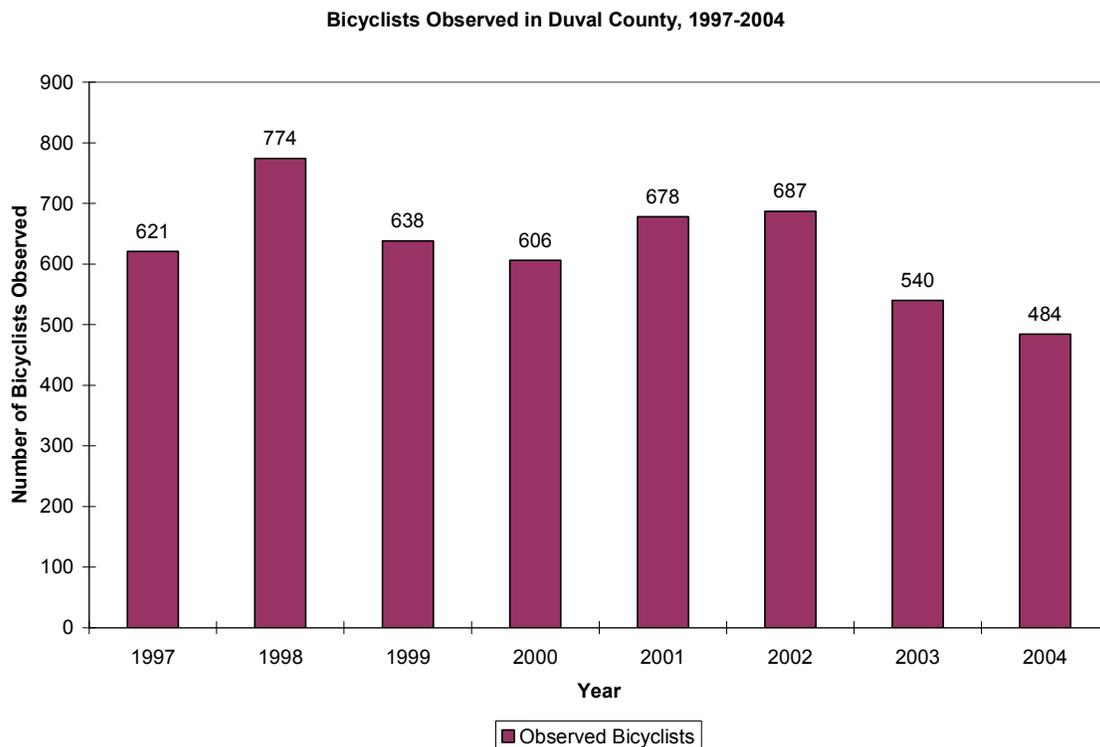


Figure 3-6 Bicyclists observed in Duval County, 1997-2004

Data from the University Medical Center's Trauma Center showed that the number of bicycle-related trauma center visits decreased from 9 (January to August 1996) to 5 (January to August 1997). The bicycle helmet usage rate among those treated increased from 0% in 1996 to 20% in 1997.

In all of 1996, there were 325 bike injuries in Duval County, with an estimated cost of \$33.98 million. During the first eight months of 1997, there were 105 bike injuries, with an estimated cost of \$11.13 million.

In all of 1996, there were five bike fatalities in Duval County. During the first eight months of 1997, there was one bike fatality.

Additional Information More information about Duval County’s Traffic, Bicycle and Pedestrian Education Program can be obtained from the following sources:

- Stephen McCloskey, Injury Prevention Program Manager, Duval County Health Department, (904) 665-2308
- Kinney, Lance and Stephen McCloskey. *1997 Duval County Bicycle Helmet and Child Bicycle Riding Behavior in Traffic Observational Survey*. July 31, 1997.
- McCloskey, Stephen M. *Duval County Bicycle Helmet & Riding Behavior in Traffic Observational Surveys*. Includes annual data for 1997-2004.

Safe Routes to School – Recommendations Based on Phase I Study Evaluation

To increase the possibility that more students will ride bicycles to school, the researchers recommend that Safe Routes to School programs in Florida implement the following activities:

- Incorporate education, engineering, encouragement, and enforcement. The programs in Brevard County and Duval County focused on delivering bicycle safety education to children. Marin County went beyond safety education to include infrastructure improvements, promotional events, and crossing guards.⁴⁷ Planned activities in FDOT District 7 include bicycle safety education, bicycle rodeos, and school flashers.
- Target children’s attitudes towards wearing bicycle helmets. The local Bicycle/Pedestrian Coordinator in Brevard County, FL attributed the lack of an increase in the percentage of students riding bicycles to the bike helmet law (some children chose not to ride instead of having to wear a helmet because they thought that it was not “cool” to wear a helmet).

⁴⁷ It should be noted that Florida is the nationally recognized leader with regards to training crossing guards and creating procedures to address their placement. In Florida, crossing guard training focuses on how to cross children safely across a roadway. Including crossing guards in promotional or informational campaigns is not a typical feature of Safe Routes to School Programs in Florida, nor is it recommended that crossing guards be included in these Safe Routes programs if such inclusion would inhibit their ability to perform their primary function safely.

- Conduct before-and-after program evaluation within the same school year, so that the effects of program activities on bicycle mode share among the target audience can be observed. Marin County surveyed students and parents at the beginning and at the end of the same school year. Although Brevard County's surveys and Duval County's counts provide information on how many students are bicycling to school, the evaluation methodologies used do not lend themselves to measuring change resulting from program activities during the school year.

More students bicycling to school means more energy savings and more health benefits.

Of the programs described in this section, Marin County's California has been the most successful in terms of increasing the number of students who ride bicycles to school – from 7% in Fall 2004 (at the beginning of the school year) to 9% in Spring 2005 (at the end of the school year). The success of Marin County's program likely results from its broad scope – education, engineering, encouragement, and enforcement – and from the evaluation methodology used (surveys at the beginning and end of the school year).

While Marin County's Safe Routes to Schools Program has been successful overall, some schools within Marin County have had more success than others and some schools have not participated. The 2004-2005 evaluation report listed the keys to success for individual schools:

1. A willingness to participate in the education program. This program provides classroom educators at key grade levels. The educators provide lessons coordinated with other grade-appropriate activities. Schools that do not participate in the classroom education do not do as well as those that do, and progress made in one year at those schools will almost certainly be eroded over the summer months. Through the educational component long-term change is achieved.
2. Active volunteers remain a key to the success of the Safe Routes program. Volunteers promote the program with parents, through articles written for the school newsletter, telephone trees, or other means of communicating with parents. Schools can only participate in Safe Routes to Schools if they have active team leaders and volunteers with interest in working with the Safe Routes team.
3. The most successful schools participate in at least one of the all-school events offered by Safe Routes to School such as the Frequent Rider Miles contest or regular Walk and Roll

to School Days. Involving the whole school reinforces the lessons taught at specific grade levels and continues the teaching process.

Marin County's experiences suggest that the success of Safe Routes to School programs in Florida will depend on individual schools' participation as well as that of the school district. Thus, the researchers recommend that individual schools in Florida incorporate bicycling in classroom education, identify and work with active and committed volunteers, and participate in a variety of all-school events.

CHAPTER 4 EDUCATION AND MARKETING

This portion of the Conserve by Bicycle Phase I Report evaluates the energy savings benefits of educational and marketing programs that promote bicycling. These programs typically focus on encouraging people to use bicycles for commuting, however some promote cycling as an active living recreational choice. Education and marketing programs often promote bicycling by providing information (for example, where to ride and how to ride safely) and offering incentives (such as prizes for participation in a Bike-to-Work Week). Other programs work within their community to let individuals “earn” bicycles by performing hours of community service.

One of the goals of the Conserve by Bicycle Program Study is to determine:

- *Where the use of education and marketing programs can help convert motor vehicle trips into bicycle trips.*

Measurable Criteria

An education and marketing program results in energy savings and health benefits if the implementation of that program results in individuals who would otherwise have driven cars now choosing to ride bicycles. Consequently, mode shift was chosen as the measurable criteria for this evaluation. Thus, as with other literature searches, studies, programs that demonstrated the effectiveness of these two objectives were sought and evaluated.

Literature Search

As with the other focus areas, a literature search was conducted to determine what education and marketing programs to promote bicycling had been implemented in Florida and across the United States. The researchers were specifically looking for programs that could document a mode shift. Some of the findings of this literature search are described below. The complete literature search pertaining to education and marketing programs is included as Appendix Q of this report.

Only one relevant study was found that described a Florida program met the Study criteria: an evaluation of the effectiveness of Bike on Bus programs, which provided significant

data on the effectiveness of these programs. This Bikes on Bus study⁴⁸ found that Bike on Bus Programs were the reason many people chose to ride the bus rather than use some other mode and that over a third of the individuals taking advantage of the program did not possess valid drivers licenses.

Studies and evaluations on more varied programs were available from areas outside of Florida. Many of these programs included government agency led efforts such as Bike to Work Day (week or month) and commuter assistance programs. Others included partnerships with local businesses to promote cycling to work. Several of these programs included before-and-after evaluations documenting their effectiveness (these will be discussed in the next section of this report).

Two international reports were also reviewed as part of this effort. One documented the effectiveness of a Bike to Work program in Melbourne, Australia. This study reported that 14% of the participants had never ridden a bike to work before the event and that 4 months later 27% of these “first timers” were still riding to work. The other was a Canadian study which discussed possible reasons Canadians cycle more than US residents, but the paper did not provide not quantifiable data.

Research Plan

Other than for Bike on Bus programs, the literature search described above found no information related to the effectiveness of education/marketing programs in Florida. To accurately quantify the benefits of these programs in Florida’s built environment, data will need to be collected on programs implemented in the State during the Phase II portion of this Study. The mode shift resulting from education and marketing programs will be measured using before-and-after surveys of participants and bicycle counts. To evaluate these programs, a potential program would be identified prior to its being implemented. Bicycle counts in the target area, or potential participant surveys at the business sites, governmental agencies, schools/universities or other sites being targeted would be performed to obtain baseline data. Supplemental data will be collected several months after program implementations to identify the number of individuals

⁴⁸ Center for Urban Transportation Research. *A Return on Investment Analysis of Bikes-on-Bus Programs*. University of South Florida, Tampa, FL, 2005.

who have shifted to bicycling as a travel mode for utilitarian trips. Additional insight into increases in cycling could be obtained by counting bicycles in bicycle parking facilities located in the area targeted by the education/marketing campaigns.

The researchers worked with the Steering Committee to identify programs in Florida that would be implemented during the period of this Phase I study. When none were identified, an email was sent to all of Florida's local Bicycle/Pedestrian Coordinators (all MPOs and many towns and cities in Florida have an individual with this title) requesting information on upcoming education/marketing programs. Again, no programs were identified. However, four ongoing Florida Programs were identified. Three of these programs have no evaluation component. The fourth does have an evaluation component, though it is still in an early phase of implementation and data will not be available until after the completion of this Phase I Report.

Of particular note is that no bike map distribution programs were found to have documented their effectiveness in encouraging bicycle riding. Bicycle maps have a self-selecting nature of the distribution (those who want bike maps ask for them). Combined with the fact that they both market bicycling and educate bicyclists with regard to where it is pleasant to ride, bike maps seem an ideal tool for increasing recreational riding. However, to document their effectiveness a separate evaluation study would be required.

Because no programs could be identified as being implemented in Florida during the Phase I study period, the researchers delved further into those programs for which information could be found nationwide. These program evaluations are discussed in the next section.

While the results of these programs implemented in other states certainly have relevance to this Conserve by Bicycle Program Study, they may not be able to provide accurate predictions of how such programs would affect bicycling rates in Florida. To obtain this information it would require that the Phase II before-and-after research described above be performed here in Florida.

Program Evaluations

To obtain information on the effectiveness of the education/marketing programs on mode shift, the researchers reviewed the following education and marketing programs:

1. Interstate TravelSmart (Portland, OR)
2. Eastside Hub Project (Portland, OR)

3. SmartTrips Northeast (Portland, OR)
4. SmartTrips Southeast (Portland, OR)
5. SmartTrips (Greeley, CO)
6. Commuter Bicycle Coach (Fort Collins, CO)
7. Bike Commute Challenge (Portland, OR)
8. Bicycle Commuter Contest (Thurston County, WA)
9. South Florida Commuter Services
10. Tampa BayCycle (Tampa, FL)
11. Bay Area Commuter Services (Tampa-St. Petersburg, FL)

The first five programs target all residents in their respective communities, and encourage them to travel by bicycling, walking, transit, or carpooling, instead of driving alone. The remaining programs target existing and potential bicycle commuters. Of these programs, the following provided estimates on energy savings:

- Portland SmartTrips Northeast
 - 988,000 gallons of gas (at \$3.00 per gallon, translates into nearly \$2,964,000 in energy savings)
- Thurston County Bicycle Commuter Contest
 - 3,000 gallons of gas (\$9,000 in energy savings)

Some programs did not provide estimates on energy savings, but included data on reductions in vehicle miles traveled, from which energy savings can be calculated:

- Portland Bicycle Commuter Challenge – 627,938 vehicle miles reduced (at one gallon saved for every 20 vehicle miles not driven, translates into \$94,000 in energy savings)
- Greeley Commuter Bicycle Club
 - 2002 – 11,360 vehicle miles reduced (nearly \$2,000 in energy savings)
 - 2003 – 29,434 vehicle miles reduced (over \$4,000 in energy savings)
 - 2004 – 38,933 vehicle miles reduced (nearly \$6,000 in energy savings)

Other findings include the following:

- Interstate TravelSmart, 2004
 - Bicycling increased from 3% to 5% of all trips.
 - The program contributed to an increase in physical activity of 25 hours per person per year, as a result of more bicycling, walking, and access to/from transit.

- Eastside Hub, 2005
 - Peak-hour bicycle counts showed 23% more bicyclists at the end of the program than at the beginning.
 - Bicycling increased from 4% to 6% of leisure trips.
 - Residents took an average of 1.62 new bicycling trips every week.

These programs did not provide sufficient data to allow calculation of energy savings and health benefits. However, the available data are evidence that the programs have increased levels of bicycling in the target population.

Tampa BayCycle is a program promoting bicycling to work, school, or play. As of May 2007, Tampa BayCycle's 2007 Bicycle Commuter Challenge is underway. A website has been developed in which participants can log their bicycle trips and miles ridden.

Bay Area Commuter Services includes a program which links up cyclists to "bikepool" to work. They do not track the number of participants or the miles of commuting resulting from their program.

Detailed program descriptions are provided below.

Portland, OR – Interstate TravelSmart

Program Type The Interstate TravelSmart program included the following Conserve by Bicycle evaluation elements:

Education and marketing

Partnerships

Location The Interstate TravelSmart program was conducted in north and northeast Portland, Oregon.

Description (<http://www.portlandonline.com/transportation/index.cfm?c=43819&a=142341>) TravelSmart, used in more than 300 projects around the world, identifies individuals who want to change the way they travel. It provides individualized information and training to help these people take transit, bike, walk, or carpool. The City of Portland, with support from the Oregon DOT, TriMet, and Metro, conducted the first large-scale TravelSmart project in the U.S.

The Interstate TravelSmart project was conducted after the completion of the Interstate MAX light rail line. As part of the evaluation process, a control group was also surveyed to identify changes in travel due to system improvements and those that are due to system improvements plus individualized marketing.

Program Activities The project consisted of the following activities:

- “Before” survey – In April and May 2004, a random survey of 1,460 persons in the target area was conducted to determine how they travel.
- Individualized marketing – This period of personalized contact focused on those persons who had expressed an interest in receiving information about travel using environmentally friendly modes. To start, 6,281 households were contacted, of which 5,753 (92%) participated in a brief telephone interview. During the interviews, 3,418 households expressed an interest in receiving information about travel using environmentally friendly modes. They were mailed a service sheet so they could indicate the types of information they wanted. Information was delivered (by bicycle) to the 2,624 households that returned the service sheet. One hundred eight households requested further services and received home visits from “Travel Ambassadors.” Of the 108 households that received home visits, 34 of them were primarily interested in bicycling.
- “After” survey – One year after the initial survey, a random survey of 1,708 persons was conducted to measure changes in travel behavior.
- In-depth study – A one-hour-long home interview was conducted with selected persons to determine the potential for travel behavior change.

Participants Bicycling increased from 3% to 5% of trips, while car travel decreased from 81% to 73% of trips (Figure 4-1).

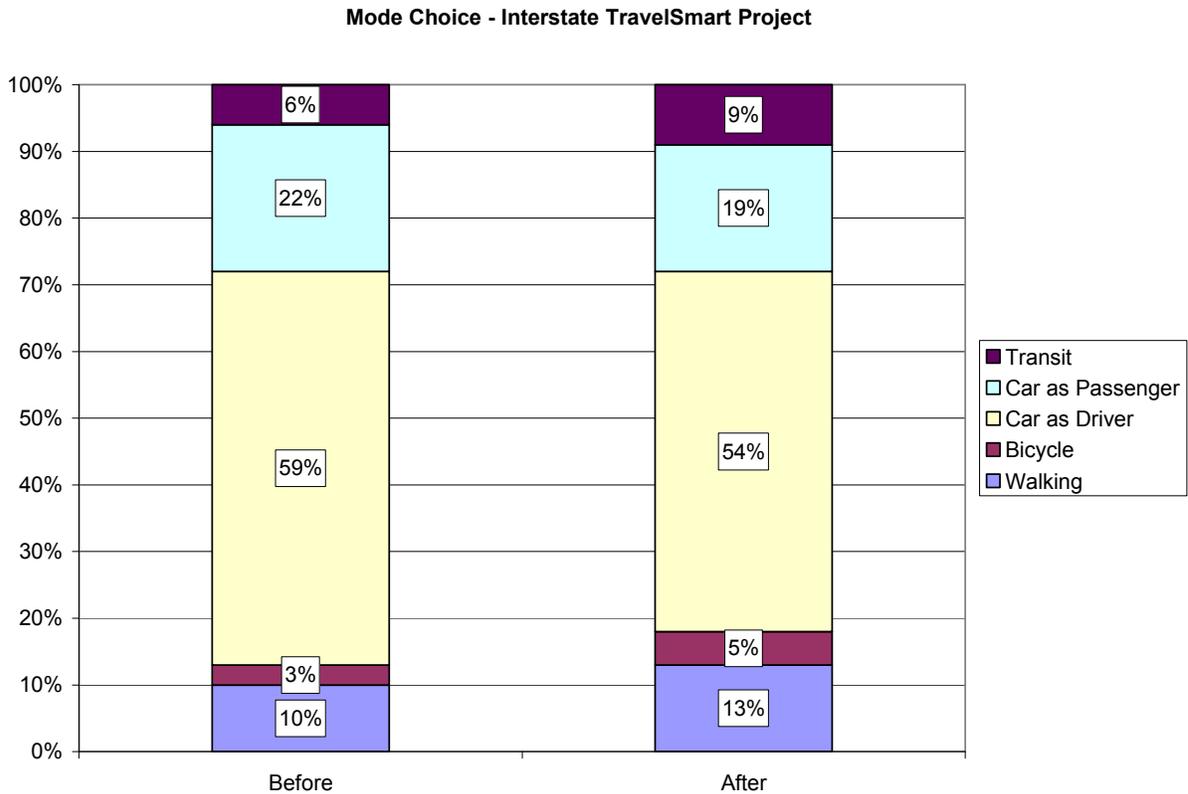


Figure 4-1 Mode choice, Interstate TravelSmart Project

Car travel decreased in the target area (where TravelSmart was conducted), and car travel also decreased in the control group, due to the new light rail line. After adjusting for the changes in the control group, the results show that car travel in the TravelSmart area decreased by an additional 9% compared to the control group. There was a total reduction of 6.8 million (14%) vehicle miles traveled. The reduction in the TravelSmart area was 14%, compared to a reduction of 8% in the control group.

The combination of light rail and TravelSmart increased physical activity 25 hours (29%) per person per year in the target group. This increased activity resulted from a combination of more bicycling, walking, and access to/from transit.

Additional Information More information can be found at the program website:

<http://www.portlandonline.com/transportation/index.cfm?c=43819&a=142341>

Portland, OR – Eastside Hub Project

Program Type The Eastside Hub Project included the following Conserve by Bicycle evaluation elements:

Education and marketing

Partnerships

Location This program was conducted at the Eastside Hub in Portland, Oregon.

Description In 2005, the City of Portland Transportation Options Division targeted the Eastside Hub with various programs and projects to increase bicycling, walking, transit, carpool and car sharing trips taken by residents and employees and to also promote physical activity. The Eastside Hub is bordered by SE 30th Avenue to the west, SE 82nd Avenue to the east, Interstate 84 to the north, and SE Woodward Street to the south (Figure 4-2).



Figure 4-2 Eastside Hub, Portland
(Source: Transportation Options)

Program Activities The project consisted of these activities: (from <http://www.portlandonline.com/shared/cfm/image.cfm?id=101216>)

From March through November 2005, Eastside Hub Project programs provided opportunities and written materials to Eastside Hub residents and employees.

Bicyclist and Pedestrian Access Improvements Bikeway Network Completion Capital Improvement Projects funding was used to improve the bikeway arterial crossings of SE 16th Avenue at Hawthorne and SE 41st Avenue at Hawthorne. Additionally, bike racks were installed at 29 businesses in the target area.

Getting Around Portland Options (GAP Options) Transportation Options sent each household a mailer with an order form for informational materials. To ensure prompt delivery, the target area was divided into ten sectors and the order forms were mailed in batches over a ten-week period. This made possible a two- to four-day turnaround time for almost every request. A reminder postcard was sent to increase participation. An online order form was developed and proved to be effective as nearly one-third of all orders were received online. Out of 20,656 households in the target area, 4,683 (22.7%) ordered materials.

Nearly 3,700 households ordered materials about bicycling. The most popular material by far was the bike kit (Figure 4-3).

Biking Materials Ordered in the Eastside Hub

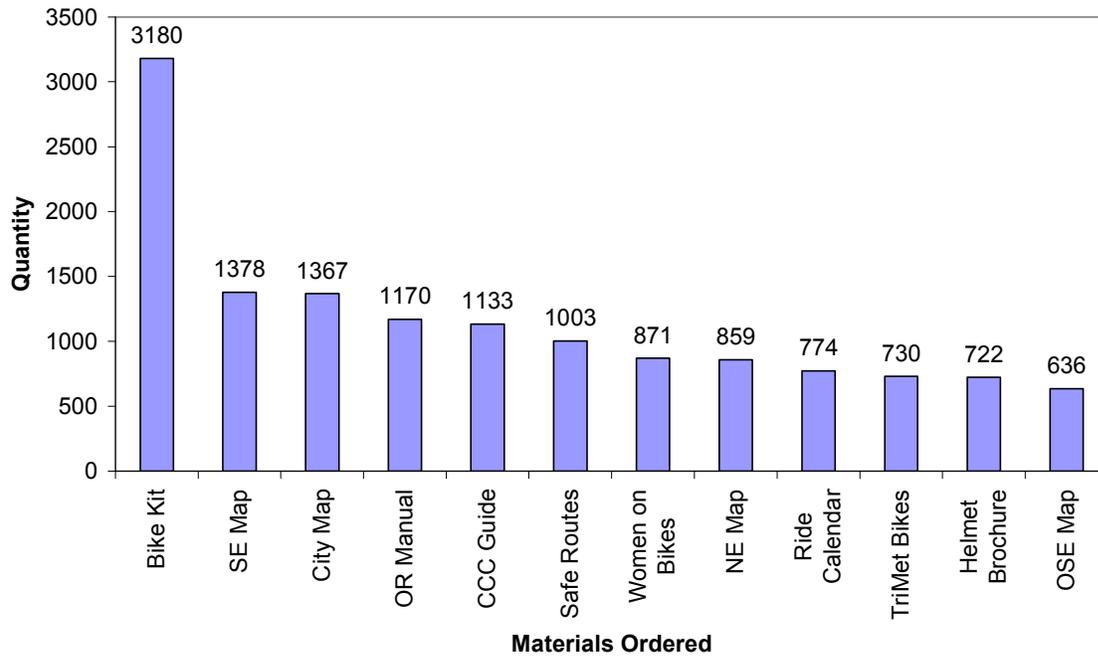


Figure 4-3 Biking materials ordered
(Source: Transportation Options)

Getting Around Portland Eastside Hub Newsletter Residents received five newsletters, starting in March and every two months thereafter. The newsletters provided information on traffic safety and Eastside Hub Project programs, a calendar of events, and other resources. A survey of 5,200 households indicated that 64% of respondents read the newsletter.

Originally only the first newsletter was to go to all households, and subsequent newsletters were to be sent to residents who had returned the GAP Options order form (see above). After the first batch of order forms was mailed, Transportation Options staff decided to send the second newsletter to all households that had not yet received the order form to encourage participation.

Portland by Cycle campaign The goal of the Portland by Cycle campaign was to encourage new and existing bicycle riders to ride for more trips and new trip purposes. To help residents overcome barriers to cycling, Transportation Options staff offered a bike kit with accessories and information, Summer Cycle rides (see below), and Women on Bikes rides and clinics (see

below). Bicycle helmet distribution targeted younger riders, and staff and volunteers offered guided commutes and free bike route planning.

The bike maps were a huge hit. The reflective leg bands, calendar of events, and refrigerator magnet printed with cyclist resources were also well received. However, the guided commutes were sparsely attended.

Summer Cycle The Summer Cycle rides included 16 ten-mile rides in July and August. One hundred fifteen people participated in the first two rides. Most participants fit the profile of Transportation Options' desired audience: new or inexperienced riders needing an extra boost of confidence and experience to feel more comfortable on their bicycles in traffic.

Women on Bikes Women on Bikes was a series of clinics, conversations, and rides. This program garnered local and national media interest. The program was successful in getting newer cyclists riding. Clinic and conversation topics included bike selection, bike and cyclist gear, bike handling skills, basic bike maintenance, the city's bikeway network, cyclists' rights and responsibilities, how to ride with children, how to shop by bike, and advocacy. The rides enabled participants to practice skills, try different routes, meet other women to ride with, and demonstrated the ease of commuting by bike.

Smart Living Classes Transportation Options worked with individuals and organizations to offer nine free classes on topics such as Intro to Bike Commuting and Repair; Biking with Kids; Cyclists' Rights, Responsibilities, and Advocacy; How to Do a Community Bikeability Assessment; and Shopping by Bike.

Get to Work! – Small business TDM. Transportation Options worked with small businesses to provide employers and employees information on biking, walking, transit, and carpooling. This was funded by a TriMet Jobs Access and Reverse Commute grant. The program offered walking and biking maps and kits for employees, free bike rack installations, transit programs, and carpool information. Transportation Options staff met with all neighborhood business associations (Belmont, Hawthorne, Division/Clinton). In addition, the Portland Office of Transportation installed 22 bike racks at the request of businesses in the Eastside Hub.

Kids on the Move In the summer, Transportation Options met with families that attended schools in the Eastside Hub. One school, Edwards Elementary, closed at the end of the school year and parents were concerned about safe walking and biking routes to the new school, Abernethy Elementary. In June 2005, parent volunteers and staff from Edwards assisted with an after-school event that included route planning, helmet fitting and giveaways, safety talks, general walking and biking information, and a guided bike ride to Abernethy. In September 2005, Transportation Options handed out information on bike and walk planning. Volunteers and staff also fitted and gave away 100 helmets.

Youth helmet distribution Transportation Options promoted the use of properly fitted bicycle helmets at all events and activities in the Eastside Hub through brochures, by word of mouth, and by requiring them at all Options-sponsored bike events.

Transportation Options distributed 390 helmets to children and adults at events sponsored by Kaiser Permanente, Mt. Hood Head Start, Edwards School, and Abernethy School. Helmets were also distributed at Bike and Walk to School Day in October 2005, in conjunction with the Traffic Investigation Division's Safe Routes to School program and the Bicycle Transportation Alliance.

Providence Employee Outreach Transportation Options staff worked with Providence Portland Medical Center's transportation committee to promote transportation options to employees and patients during their large construction project. Transportation Options created and distributed 200 custom bike maps that detailed routes and parking alternatives for employees.

New Resident Packets After the initial mailing in early April (see Getting Around Portland Options), new homeowners to the area were welcomed with mailers offering an opportunity to request neighborhood bike maps, bus and light rail schedules, and other transportation information. Of the 160 order forms mailed, 35 households (22%) requested information.

Partnerships The Eastside Hub project was done in partnership with several entities. They are described below. (from <http://www.portlandonline.com/shared/cfm/image.cfm?id=101216>)

Health Care Providers Providence Portland Medical Center provided significant financial support for the Portland by Cycle Campaign. It also partnered with Transportation Options to implement an employee travel demand management (TDM) campaign to encourage employees to take transit, bike, and/or walk to work.

Kaiser Permanente offered residents the opportunity to call a health counselor for free advice and suggestions on starting a fitness program.

Media Throughout the Eastside Hub project, Transportation Options invited the press to scheduled outreach events.

Businesses Fifty-six businesses participated in a “Short Tripper” coupon book to provide residents an opportunity to discover local businesses to which they could walk and bike.

All neighborhood business associations recognized by the Office of Neighborhood Involvement were contacted via phone, business association meetings, mailings, newsletters, maps, brochures, event flyers, and schedules.

Get to Work! (see above) reached all area small businesses by mail and many by personal contacts to encourage employees and customers to walk, bike, and take transit to work and to shop. Seventy-five businesses participated.

Community Groups In partnership with Shift to Bikes (a non-profit bicycle advocacy group), Transportation Options purchased 500 sets of bike lights that were installed by volunteers from Shift to bikes. Installation took place at events and at opportune times and locations in the Eastside Hub.

Participants Baseline and end-of-project bicycle counts were conducted at various locations in the Eastside Hub. The counts showed an average 23% increase in cycling (Figure 4-4).

Transportation Options hired a professional survey firm to conduct random telephone surveys. The pre-campaign surveys were in February and March 2005; the post-campaign surveys were in October 2005. Each round of surveys consisted of 150 residents in the “test”

group (Eastside Hub) and 150 residents in the “control” group (outside of, but adjacent to, the Eastside Hub).

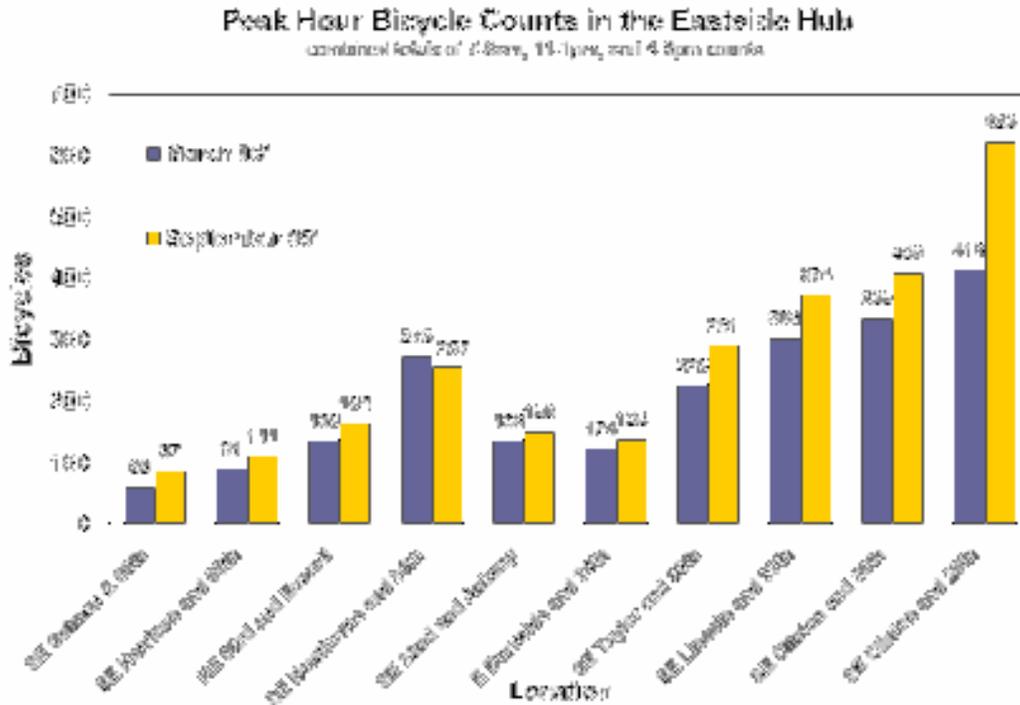


Figure 4-4 Peak hour bicycle counts in the Eastside Hub
 (Source: Transportation Options)

The survey results did not show a statistically significant change in biking behavior in the target area as a whole. However, mode split for leisure trips increased from 4% to 6%.

Transportation Options mailed written program evaluations to all households that had provided names and addresses during Eastside Hub programs, for a total of 5,200 households. Residents could either complete the survey and mail it back or fill it out electronically. After four weeks, 1,004 surveys were returned, for a response rate of 19%.

Respondents indicated that they were taking an average of 1.62 new biking trips every week, many of them for errands, fitness, and shopping (Figure 4-5).

What type of new biking trips have you taken in the past few months?

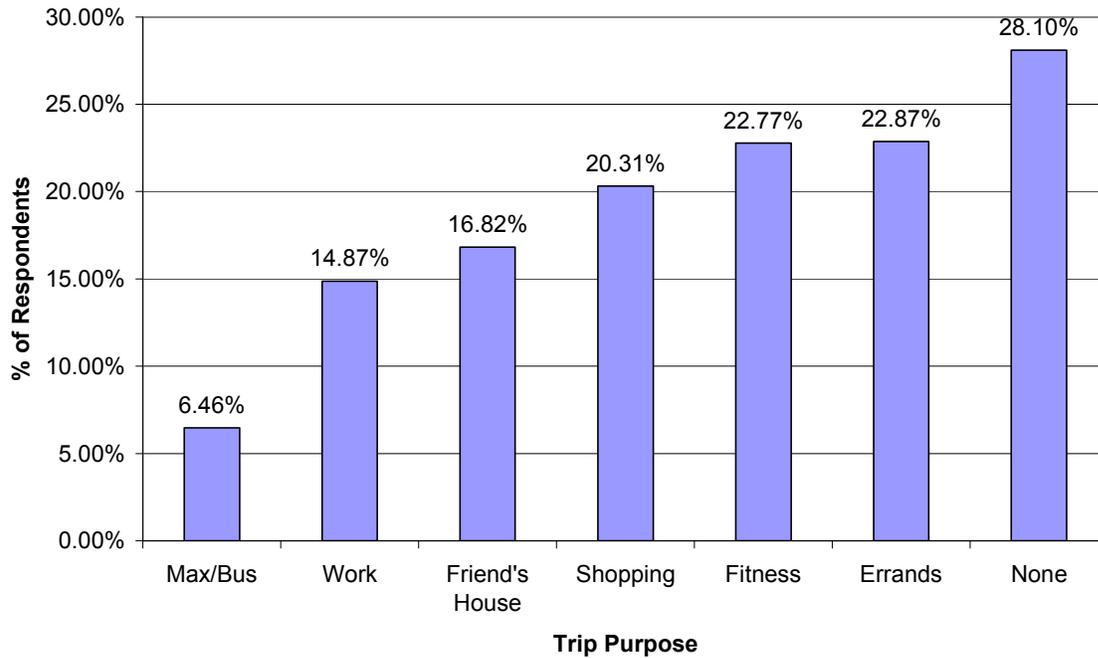


Figure 4-5 Trip purposes for new biking trips
(Source: Transportation Options)

Additional Information More information on the Eastside Hub project can be obtained from the following sources:

- City of Portland Office of Transportation. *Eastside Hub Target Area Program Comprehensive Evaluation Report*, December 2005. Available online at <http://www.portlandonline.com/shared/cfm/image.cfm?id=101216>
- Portland Office of Transportation. *Appendix A: Eastside Hub Target Area Program Measurement Tools and Results Report*, December 2005. Available online at <http://www.portlandonline.com/shared/cfm/image.cfm?id=101217>



Portland, OR - SmartTrips Northeast

Program Type The SmartTrips Northeast program included the following Conserve by Bicycle evaluation elements:

Education and marketing

Partnerships

Location The SmartTrips Northeast program was conducted in 11 neighborhoods with 58,000 residents in Portland, Oregon.

Description (from <http://www.portlandonline.com/shared/cfm/image.cfm?id=145046>)

Each year the City of Portland Transportation Options Division selects an area of Portland to target with various programs and projects to increase bicycling, walking, transit, carpool, and car sharing trips taken by residents and employees, and to also promote physical activity. In 2006, the SmartTrips Northeast Hub was selected.

The SmartTrips Northeast Hub Plan built and expanded upon partnerships and programs with health organizations, neighborhoods, businesses, and residents in 11 neighborhoods: Columbia, Woodlawn, Concordia, Vernon, Sabin, Alameda, Beaumont-Wilshire, Irvington, Sullivan's Gulch, Grant Park, and Hollywood (plus parts of King and Eliot) (Figure 4-6).



Figure 4-6 Northeast Hub, Portland
(Source: Transportation Options)

Program Activities The project consisted of these activities: (from <http://www.portlandonline.com/shared/cfm/image.cfm?id=145046>)

From March through November 2006, Northeast Hub programs provided opportunities and written materials to Northeast residents and employees to promote ways to get around Portland by transit, walking, biking, carpooling, and other alternatives to drive-alone trips.

Getting Around Portland Options (GAP Options) Transportation Options sent each household a mailer with an order form for informational materials. To ensure prompt delivery, the target area was divided into ten sectors and the order forms were mailed in batches over a ten-week period. This made possible a two- to four-day turnaround time for almost every request. A reminder postcard was sent to increase participation. An online order form was developed and proved to

be effective as nearly 44% of all orders were received online. Out of 24,000 households in the target area, 4,590 (19%) ordered materials.

About 3,700 households ordered materials about bicycling. The most popular material by far was the bike kit (Figure 4-7).

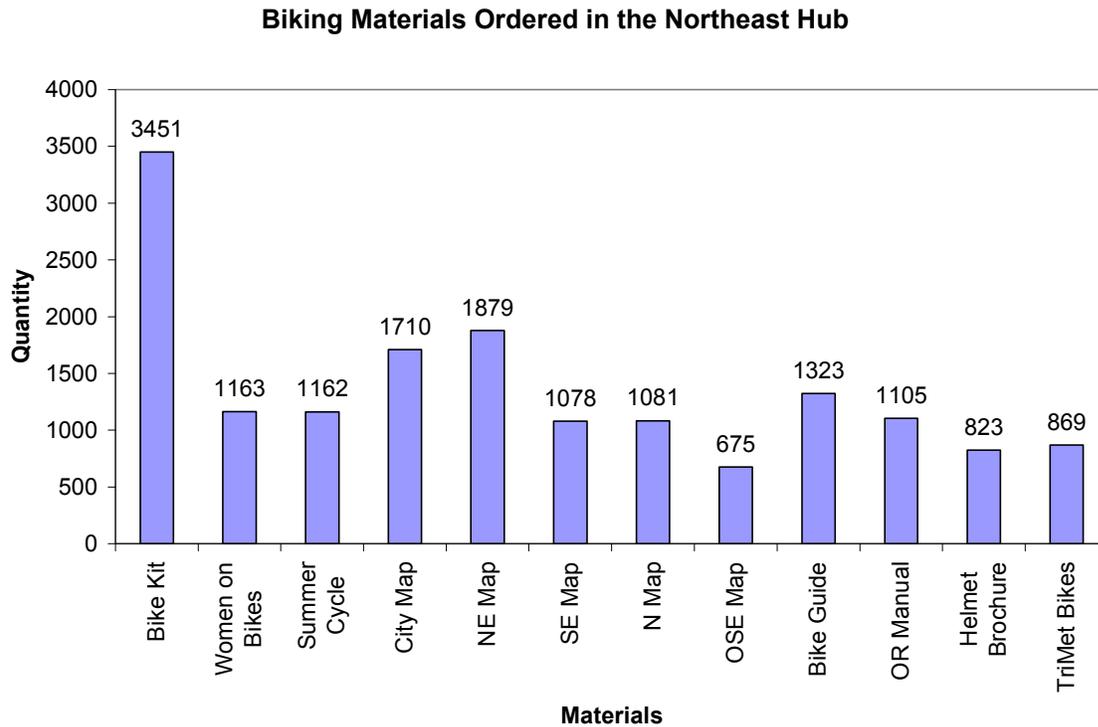


Figure 4-7 Biking materials ordered
(Source: Transportation Options)

Getting Around Portland Northeast Hub Newsletter Residents received five newsletters, starting in March and every two months thereafter. The newsletters provided information on traffic safety and Northeast Hub Project programs, a calendar of events, and other resources.

The first two newsletters were sent to all households in the Northeast Hub. Subsequent issues were sent to residents who had expressed interest by returning the GAP Options order form (see above) or attending an event.

Portland by Cycle campaign The goal of the Portland by Cycle campaign was to encourage new and existing bicycle riders to ride for more trips and new trip purposes. To help residents

overcome barriers to cycling, Transportation Options staff offered a bike kit with accessories and information, Summer Cycle rides (see below), Women on Bikes rides and clinics (see below), bicycle helmet distribution, Get Lit bicycling lights distribution (see below), and individualized bike route planning.

The bike kit proved popular; seventy-five percent of all households ordered a kit. An additional 1,000 kits were made available at Transportation Options events and activities. The bicycle maps were in high demand. The reflective leg band, calendar of events, and stickers printed with cyclist resources were also well received.

Transportation Options staff prepared 45 individualized bicycle route trip plans requested by Northeast Hub participants.

Summer Cycle The Summer Cycle rides included 17 ten-mile rides in July and August. A total of 321 riders participated. Most participants fit the profile of Transportation Options' desired audience: new or inexperienced riders needing an extra boost of confidence and experience to feel more comfortable on their bicycles in traffic.

Women on Bikes Women on Bikes was a series of clinics, conversations, and rides. This program garnered local and national media interest. The program was successful in getting newer cyclists riding. Clinic and conversation topics included bike selection, bike and cyclist gear, bike handling skills, basic to more in-depth bike maintenance, the city's bikeway network, cyclists' rights and responsibilities, and winter commute tips. The rides enabled participants to practice skills, try different routes, meet other women to ride with, and demonstrated the ease of commuting by bike.

Get Lit Transportation Options worked with Shift to Bikes (a non-profit bicycle advocacy group) to distribute bicycle lights to needy individuals. Transportation Options purchased 400 sets of bike lights. Installation took place at events and at opportune times and locations in the Northeast Hub area. Get Lit obtained grants and donations for the purchase of additional bicycle light sets (front and back).

In 2006 Get Lit distributed and installed 362 bicycle light sets. Inspired by this approach, City Commissioner Sam Adams, along with Transportation Options, launched a See and Be Seen

bicycle light safety campaign, adding public service announcements to the light distribution efforts.

Youth helmet distribution Transportation Options promoted the use of properly fitted bicycle helmets at all events and activities in the Northeast Hub through brochures, by word of mouth, and by requiring them at all Options-sponsored bike events.

Transportation Options distributed 126 helmets to children at the kick-off event. Helmets were also distributed at Bike+Walk to School Day events in conjunction with the Traffic Investigation Division's Safe Routes to School program and the Bicycle Transportation Alliance.

Smart Living Classes Transportation Options worked with individuals and organizations to offer nine free classes on topics such as Bike Commuting in Portland, Bike Touring Basics, Shopping by Bike, and All Season Cycling.

Get to Work! – Small business TDM Transportations Options worked with over 50 small businesses to provide employers and employees information on biking, walking, transit, and carpooling. Nineteen businesses requested a free bike parking rack for their business. There were 177 bicycle kits delivered to employees. Over the last three years, Get to Work! has helped over 180 small businesses in Portland.

Partnerships The SmartTrips Northeast project was done in partnership with several entities. They are described below.

(from <http://www.portlandonline.com/shared/cfm/image.cfm?id=145046>)

Health Care Providers Transportation Options collaborated with Kaiser Permanente to provide residents with bike kits and to give out free bicycle helmets to children. Kaiser Permanente also offered classes and training sessions on healthy living and fitness as part of the Smart Living Classes (see above).

Media The media covered an overall program piece, as well as pieces on Women on Bikes (see above) and Summer Cycle (see above). The Northeast Hub project enjoyed significant media

coverage in local newspapers, and on radio and TV, as well as attention in national venues and transportation- and senior-related publications.

Businesses Seventy-six businesses participated in a “Short Tripper” coupon book to provide residents an opportunity to discover local businesses to which they could walk and bike.

Several businesses donated staff, financial support, and/or incentives:

- Krytonite donated 100 bicycle locks
- Planet Bike gave a sizeable discount for the bicycle light sets distributed through Get Lit (see above).
- Echo Restaurant, Fleur de Lis Bakery, Hannah Bea’s Poundcake and More, Reflections Coffee House, Parisi’s Gelato-Fudge-Espresso, and Tonalli’s Doughnuts & Cream sponsored the Summer Cycle rides.
- Bike Gallery helped lead several Women on Bikes clinics.
- Cycle Path donated bike lube and helped on the maintenance clinics.
- BikePortland.org provided significant support with discounted stickers and outreach on the blog.

All neighborhood business associations recognized by the Office of Neighborhood Involvement were contacted via phone, business association meetings, mailings, and newsletters. Several businesses partnered with Transportation Options to launch the SmartTrips Northeast Hub Program with the Spring Thing Health and Wellness Fair on April 29, 2006.

Get to Work! (see above) reached all area small businesses by mail and many by personal contacts to encourage employees and customers to walk, bike, and take transit to work and to shop.

Community Groups In partnership with Shift to Bikes (a non-profit bicycle advocacy group), Transportation Options purchased 400 sets of bike lights that were installed by volunteers from Shift to bikes.

The Bicycle Transportation Alliance and Shift to Bikes promoted Women on Bikes and the Summer Cycle rides through their list serves, emails, and websites.

Participants Transportation Options hired a professional survey firm to conduct random telephone surveys. The pre-campaign surveys were in March 2006; the post-campaign surveys were in September and October 2006. Each round of surveys consisted of 300 residents in the “test” group (Northeast Hub) and 300 residents in the “control” group (who did not receive any information from Transportation Options, but they were subject to other factors that may have influenced their travel behavior).

In the test group, 3.9% of all trips were taken by bicycle prior to the campaign (Figure 4-8). This figure increased to 9.9% of all trips after the campaign.

In the control group, 2.3% of all trips prior to the campaign, and 6.8% of all trips after campaign, were taken by bicycle. Therefore, bicycle trip growth was greater in the test group than in the control group.

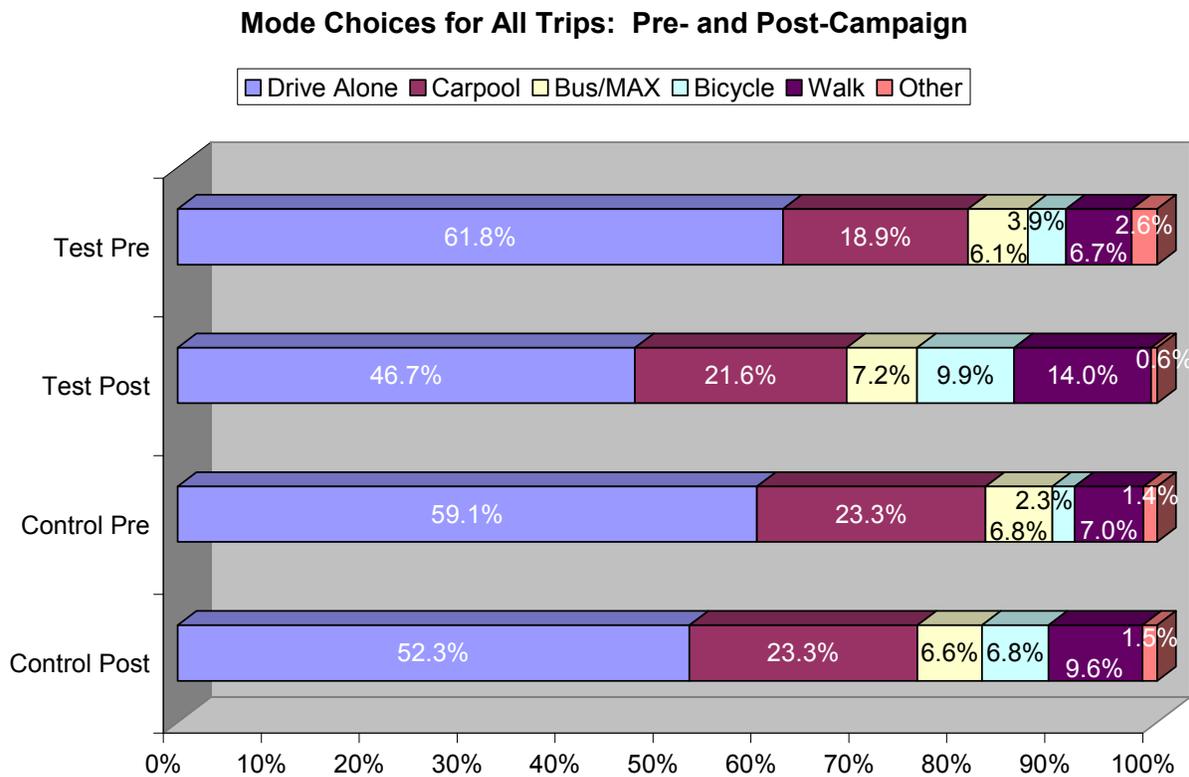


Figure 4-8 Mode choice for all trips
 (Source: Transportation Options)

SmartTrips Northeast Hub increased bicycling for all trips by 1.5%, which is equivalent to an additional 870 bike trips per day among the 58,000 residents of the Northeast Hub. The largest increase was for work and work-related trips, where bicycling increased 6.3%.

Survey respondents were asked, “What types of biking trips did you make in the past few months?” Trip purposes are shown in Figure 4-9. The total exceeds 100% because respondents were allowed to identify multiple trip purposes.

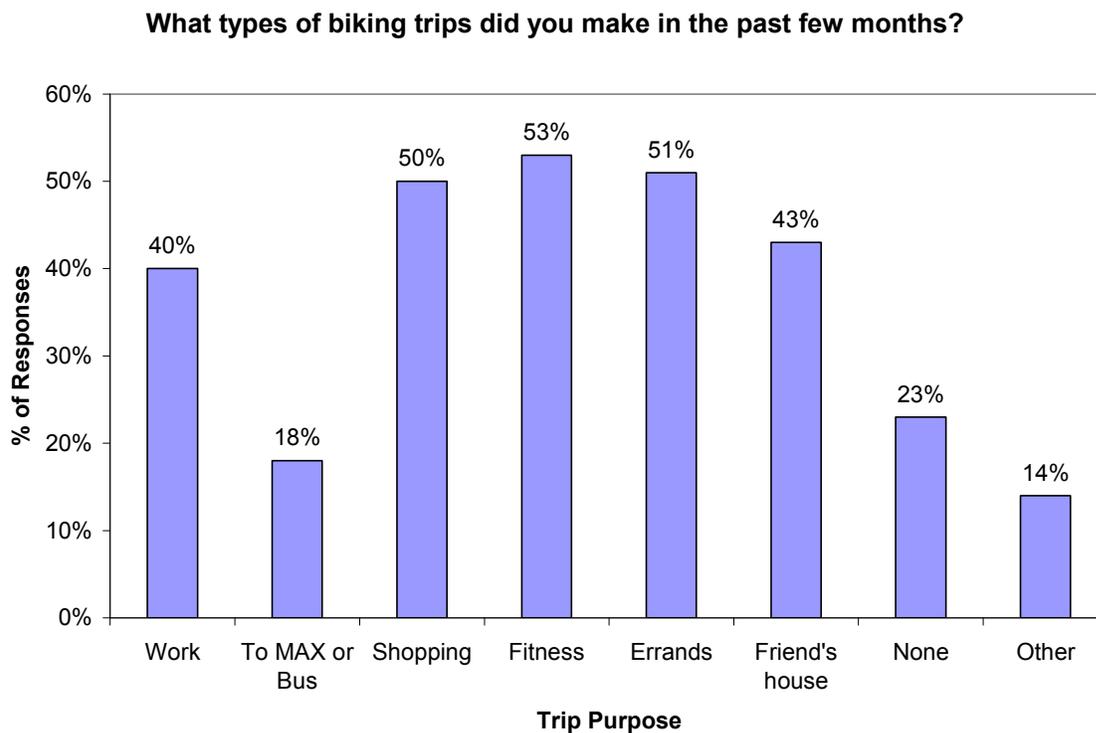


Figure 4-9 Bike trip purposes
(Source: Transportation Options)

Comparing the changes in drive-alone rates from the pre- and post-surveys between the test group and the control group showed that there was a net reduction of 1.19 VMT per day, per person, in the Northeast Hub. This translates into a reduction of over 19 million VMT in 2006. In turn, an estimated 988,000 gallons of gas were saved and pollutant emissions were reduced (Table 4-1).

Table 4-1 Reduction in Pollutant Emissions

Pollutant	Reduction (pounds)
VOC	54,035
Nitrogen oxide	45,367
Carbon monoxide	612,907
Carbon dioxide	18,705,124

Additional Information More information on the SmartTrips Northeast project can be obtained from the following sources:

- City of Portland Office of Transportation. *SmartTrips Northeast Hub Comprehensive Evaluation Report*, December 2006. Available online at <http://www.portlandonline.com/shared/cfm/image.cfm?id=145046>
- Portland Office of Transportation. *Appendices: SmartTrips Northeast Hub*, December 2006. Available online at <http://www.portlandonline.com/shared/cfm/image.cfm?id=145047>

Portland, OR – SmartTrips Southeast

Program Type The SmartTrips Southeast program includes the following Conserve by Bicycle evaluation elements:

Education and marketing

Partnerships

Location The SmartTrips Northeast program is being conducted in eight neighborhoods in Portland, Oregon.

Description (from <http://www.portlandonline.com/shared/cfm/image.cfm?id=146975>)

Each year the City of Portland Transportation Options Division selects an area of Portland to target with various programs and projects to increase bicycling, walking, transit, carpool, and car sharing trips taken by residents and employees, and to also promote physical activity. For 2007, the SmartTrips Southeast Comprehensive Plan was chosen based on transportation, community,

and financial criteria. This Plan builds and expands upon partnerships in eight neighborhoods: Ardenwald, Brentwood-Darlington, Brooklyn, Creston-Kenilworth, Eastmoreland, Reed, Sellwood-Moreland, and Woodstock (Figure 4-10). Through Metro's Regional Transportation Options grant process, the project will also include 3,400 residents in the City of Milwaukie.



Figure 4-10 SmartTrips Southeast target area, Portland
(Source: Transportation Options)

Program Activities The project consists of these activities: (from <http://www.portlandonline.com/shared/cfm/image.cfm?id=146975>)

From April through November 2007, SmartTrips Southeast programs will provide opportunities and written materials to Southeast residents and employees to promote ways to get around Portland by transit, walking, biking, carpooling, and other alternatives to drive-alone trips. These programs are modeled on the successful projects in the Interstate area (2004), Eastside Hub (2005) and Northeast Hub (2006).

The SmartTrips program has an annual budget of about \$500,000. The City receives significant contributions of services from sponsors.

Bicyclist access improvements During FY 2006/2007, Bikeway Network Completion funding will give priority to identifying and installing low cost access improvements for cyclists. Additionally, installation of bike racks in the public ROW will be promoted with area businesses and residents.

SmartTrips Southeast Options This is a mailer and online order form for materials, including:

- Portland by Cycle kit
- Women on Bikes information
- All program schedules including Senior Strolls and Rides, Portland by Cycle rides and classes

In addition, three incentives will be offered to area residents to return their order form. These will include an umbrella, a Transportation Options T-shirt, and a biking/walking book. The mailer and delivery will be conducted in waves to minimize time between ordering and delivery. A newsletter will be sent to each household to encourage participation. Each mode will be addressed and all households in the target area will receive the mailer.

SmartTrips Southeast Newsletter The first issue was distributed in April 2007 and will be delivered by mail every two months afterwards (Figures N-8 and N-9 in Appendix N). The first two newsletters will go to all households in the area. Subsequent newsletters will go to program participants.

Portland by Cycle The goal is to encourage new and existing bicycle riders to utilize their bicycles for more trips and new trip purposes. A bike kit will provide new and existing cyclists with free maps, information, and commuting accessories. The kit will aid in efficient distribution of new and existing literature, provide incentives for cycling, and help Portland residents overcome barriers to cycling. The campaign will distribute 4,500 kits to area households. Portland by Cycle and Women on Bikes will also be integral parts of the program (see below). An additional component will include free bike route planning.

Portland by Cycle rides and classes Portland by Cycle includes evening rides and classes from May through September. The rides are designed for new cyclists and those who have not been on a bike for years. Participants will tour various parts of southeast Portland and Milwaukie and learn the best ways to get around by bike. A safety briefing opens the ride program, and safety tips are offered along the ride by trained volunteer and staff ride leaders.

Transportation Options will work with individuals and organizations to offer eight free classes. Potential topics include shopping by bicycle, introduction to bike commuting, bicycle touring, riding in the rain, and basic bike maintenance.

Women on Bikes Women on Bikes is a series of clinics, conversations, and rides. The topics will include bike selection, bike and cyclist gear, bike handling skills, basic bike maintenance, the city's bikeway network, cyclists' rights and responsibilities, how to ride with children, how to shop by bike, and advocacy. Rides will enable participants to practice skills, try different routes, meet other women to ride with, and will demonstrate the ease of commuting by bike.

Senior Cycling Transportation Investigations piloted a successful program to encourage seniors to get back on their bicycles. The program includes seniors riding three-wheel bicycles in areas with no or low traffic. Transportation Options will explore continuing this new programs in the SmartTrips Southeast area.

Get to Work! – Small business TDM Through the Get to Work! program, Transportation Options works with small businesses to make it easier for employees to get to work by bike, transit, carpool, or walking. Transportation Options provides free bike racks for businesses, walking and biking maps, and kits to help employees get started.

Participants Transportation Options hired a professional survey firm to conduct random telephone surveys. The pre-campaign surveys were in September and October 2006; the post-campaign surveys will be in September 2007.

The pre-campaign survey was a random telephone survey of 600 residents who lived in the Southeast area. The survey script appears in Figures N-10 through N-15 in Appendix N.

Among all respondents, 7% of trips were made by bike. Seventy-two percent of respondents own a bike, and 9% of their trips were made by bike.

Some attitudes toward biking are depicted in Figure 4-11. Fifty percent of respondents indicated a willingness to bike to work. More than half (56%) of respondents would like to ride a bike more often but have trouble fitting it into their current lifestyle.

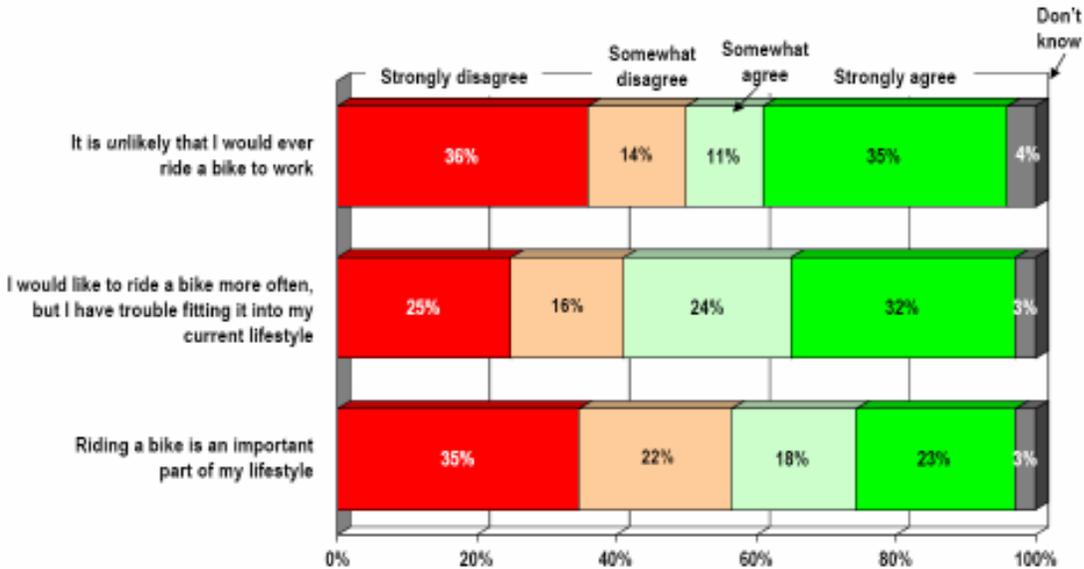


Figure 4-11 Respondents' attitudes toward biking, part 1

(Source: Transportation Options)

Additional attitudes toward biking are depicted in Figure 4-12. About two-thirds of respondents would ride on streets designed for bikes. Nearly 40% of respondents do not ride more often because they have to share the road with motor vehicles.

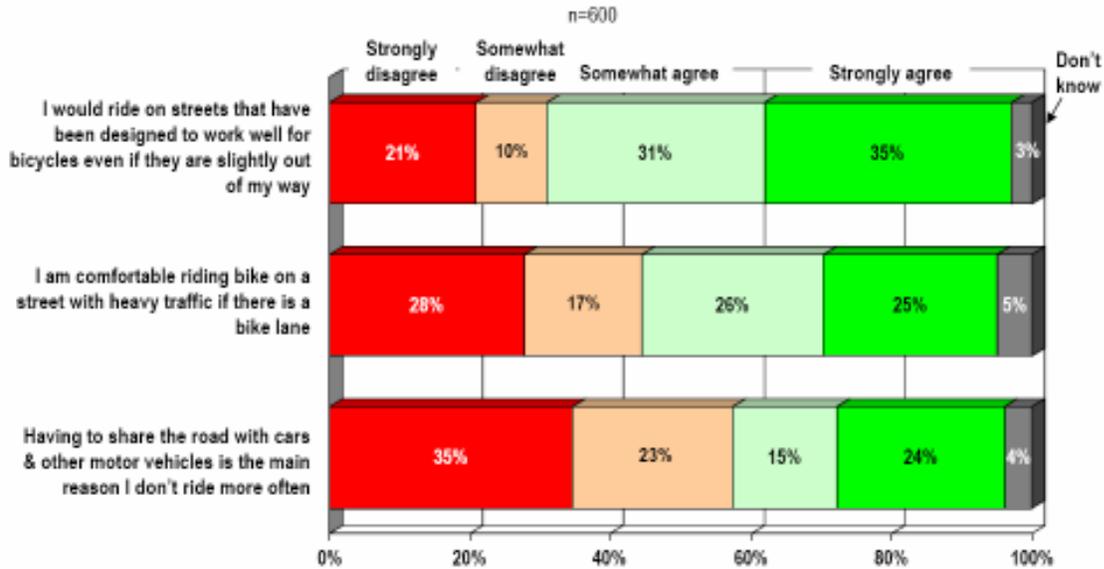


Figure 4-12 Respondents' attitudes toward biking, part 2
(Source: Transportation Options)

Although Transportation Options did not target the Southeast area in 2006, 40% of respondents recalled seeing information about SmartTrips in their neighborhood.

Additional Information More information on the Southeast Hub project can be obtained from the following sources:

- Dan Bower, Project Manager, City of Portland Transportation Options, (503) 823-5185
- Description of SmartTrips Southeast Comprehensive Area Plan, <http://www.portlandonline.com/shared/cfm/image.cfm?id=146975>
- SmartTrips newsletter, <http://www.portlandonline.com/shared/cfm/image.cfm?id=151713>
- Campbell DeLong Resources, Inc. *SmartTrips SE Hub Pre-Program Survey*.



Greeley, CO – SmartTrips

Program Type This SmartTrips program included the following Conserve by Bicycle evaluation elements:

Education and marketing

Partnerships

Location This SmartTrips program was conducted in Greeley, Colorado.

Description The SmartTrips program in Greeley encourages residents to travel by bicycling, walking, transit, carpool, and vanpool. The bicycling activities are described in the next section.

Program Activities The project consisted of these activities: (from information provided by Judith Lavelle)

Commuter Bicycle Club Bicycle commuters who live and/or work in Greeley or the neighboring communities of Evans and Windsor can log their miles for work or errands on www.SmartTrips.org to be eligible to receive prizes and discounts. The following companies and organizations are sponsors of the Commuter Bicycle Club: Kinkos, the BUS, Bike Peddler, I-Bike, The Roubaix Bicycle Company, The Finest CD's & LP's, Java Good Day, Union Colony Civic Center, Subway, and Carl's Jr.



Bicycle Depot for City of Greeley Employees Greeley's Bike Depot serves as a secure indoor bicycle parking facility for city employees who bicycle to work. It is a convenient space for bicycle commuters to transition from commute-mode to work-mode. Additionally, a loaner

bicycle is available when city employees need to run errands during the workday. The depot also serves as an example to area businesses as to how they can actively support bicycle commuting for their employees.

2004 Bike Month Record numbers of bicyclists of all ages and abilities participated in rides & events throughout Greeley's 15th annual Bike Month in 2004, yielding a 14% participant increase over 2003.

Bike Month activities included:

- Bike-to-Work Day
- Historic bike ride
- Missile site ride and tour
- Moonlight ride
- Bike to Work Fridays
- Bike to Neighborhood Nights
- Flat repair and maintenance clinics
- Bike to the Rio
- Bike to Windsor concerts

Participants at each event registered for a chance to win a 5-speed electric bicycle. All bicyclists who logged miles on My SmartTrips each had a chance to win 2 round trip airline tickets to Las Vegas.

Bike to Work Day. Bicycle commuters completed a survey on Bike to Work Day. Figure 4-13 shows how respondents heard about Bike Month in 2004.

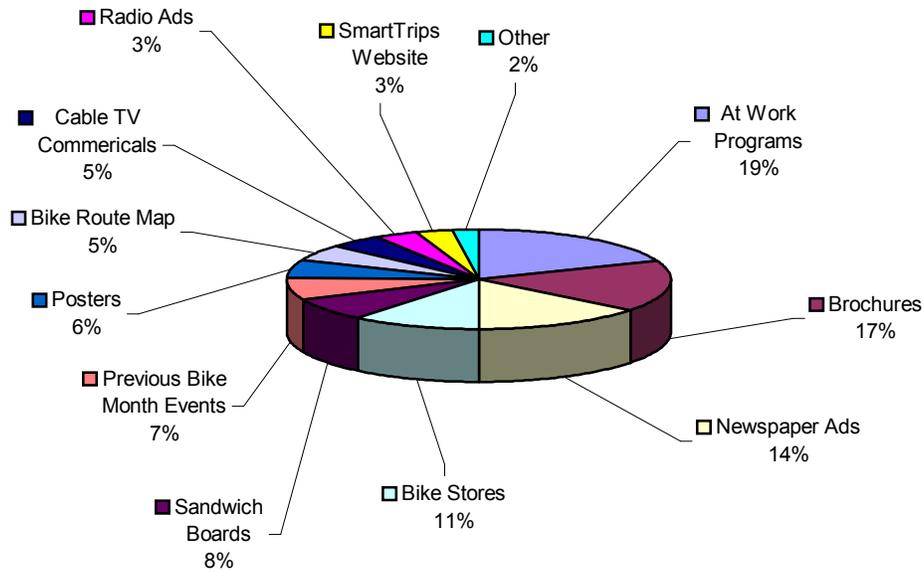


Figure 4-13 How bicycle commuters heard about Bike Month

Table 4-2 indicates, by mode, the average number of days per week and miles per week for traveling used by respondents.

Table 4-2 Days and Miles by Travel Mode

Travel Mode	Avg. DAYS per week respondents use various travel modes	Avg. MILES per week respondents travel by mode
Bicycle	2 days	20 miles
Bus	0 days	0 miles
Drive Alone	2.8 days	35 miles
Walk	1.1 days	3 miles
Carpool	0.4 days	3 miles

Bike Racks Multi-modal connections in Greeley and Evans were enhanced when Bike Racks were installed on all Fixed Route Buses in April 2001. In 2002 the bike racks were used on 3,133 occasions (Table 4-3). This grew to 5,408 in 2003, which is a 73% increase. This increase

is attributed to targeted advertising messages and greater number of SmartTrips™ Commuter Bicycle Club members using the service, averaging 451 uses per month.

Table 4-3 Summary of Bike Rack Usage on Buses

	2001 ¹	2002	2003
Average Monthly Use	110	261	451
Total Uses for the Year	770	3,133	5,408

¹ Installation of bike racks on buses occurred in April.

Marketing Marketing activities included

- 15-minute Cable TV talk show segments highlighting carpooling, Bike Month, Bus Month, Summer Youth Fare, Commuter Bicycle Club, and other alternative transportation issues.
- Distributed thousands of direct mail postcards throughout Greeley and Evans promoting Bike Month, Mile Mapper, Bus Month, and the SmartTrips™ Commuter Bicycle Club.

Participants

Commuter Bicycle Club Table 4-4 shows that the number of participants increased from 45 in 2002 to 60 in 2003 and 73 in 2004. There were also increases in days participated, trips saved, vehicle miles saved, and carbon monoxide saved.

Table 4-4 Commuter Bicycle Club Participation

SmartTrips™ Commuter Club	2002	2003	2004
Number Club Members	45 members	60 members	73 members
Days Participated	1,013 days	2,942 days	3,831 days
Trips Saved	1,950 trips	6,133 trips	6,479 trips
Vehicle Miles Saved	11,360 miles	29,434 miles	38,933 miles
Carbon Monoxide Saved	583 lbs.	1,770 lbs.	Not available

Bicycle Depot The Bicycle Depot was used during ten months in 2004, with the greatest frequency occurring from April through September. Since January 2003 the depot was used 243

times by 15 different City of Greeley employees. The loaner bicycle was used 23 times by two different employees.

Bike Month Table 4-5 compares the extent of Bike Month activities in 1999 and 2004.

Total Bike Month participation in 1999 was 111 bicyclists. In 2004 total participation for the month was 1,086 which is an 878% increase in just six years.

The 334 Bike to Work Day Breakfast Station participants worked for 68 companies in Greeley and Evans. Of the participants in 2004, 122 were new to the City’s database.

Round trip mileage for Bike to Work Day participants totaled 2,303 miles, averaging 8.8 miles per participant.

Table 4-5 Bike Month Activities, 1999 and 2004

1999	2004
Bike Month activities were limited to Greeley 3 breakfast stations; UNC, NCMC, & Aims with 111 bicycle commuters	Bike Month activities expanded into Evans & Windsor 10 breakfast stations in 3 communities with 334+ bicycle commuters (excluding Swift plant). 7 guided rides with 657 bicyclists 9 different self-paced activities; yielding 95+ riders

Additional Information More information on the SmartTrips (Greeley) project can be obtained from the following sources:

- Judith Lavelle, formerly with the City of Greeley, (970) 416-2286
- SmartTrips Greeley website,
<http://www.smarttrips.org/communities/communityDetail.aspx?communityID=5>

Fort Collins, CO – Commuter Bicycle Coach

Program Type The Commuter Bicycle Coach program included the following Conserve by Bicycle evaluation element:

Education and marketing

Location This program was implemented in Fort Collins, CO.

Description Commuter Bicycle Coach is designed to encourage and educate business employees about the fun, the freedom, the ease and the benefits of commuting by bicycle. It is sponsored by the City of Fort Collins SmartTrips office.

Program Activities In each participating organization an employee agrees to serve as the coordinator (“Commuter Bicycle Coach”) for bicycle commuting. He or she recruits fellow employees to ride a bike to work one day a week. The SmartTrips office provides guidance, information and workshops, and incentives. Promotion is primarily by word-of-mouth: the Commuter Bicycle Coach recruits riders, who in turn recruit additional riders, etc.

The cost to the City (staff time and incentives) is approximately \$100 per participant.

A mileage tracking sheet is available online at <http://fcgov.com/bicycling/cbc-tracking.php>.

Participants In its first year, there were 100 participants in Commuter Bicycle Coach. This number increased to 250 in the second year and 500 in the third year. Some participants were already bicycle commuters, while others were new to bicycling. Participating companies included Hewlett-Packard, banks, and engineering firms.

Additional Information More information on the Commuter Coach program can be obtained from the following sources:

- Betsy Jacobsen, State Bicycle and Pedestrian Coordinator, Colorado DOT, (303) 757-9982 – Ms. Jacobsen launched Commuter Coach while she was with the City of Fort Collins.

Portland, OR – Bike Commute Challenge

Program Type The Bicycle Commute Challenge included the following Conserve by Bicycle evaluation elements:

Education and marketing

Partnerships

Location This program was conducted in Portland, Oregon and Southwest Washington State.

Description This is a friendly bike-to-work competition among workplaces in Oregon and southwest Washington. Businesses and non-profits compete in one category, while public agencies and bike shops compete in categories of their own. Within the categories, workplaces are divided by number of employees. Individual cyclists can also compete.

The Bike Commute Challenge is a program of the Bicycle Transportation Alliance and has many sponsors (Figure N-16 in Appendix N).

Program Activities The project consisted of these activities: (from <http://www.bikecommutechallenge.com/oregon/about>)

Each company has a coordinator who registers the workplace. Company employees register themselves on the Bike Commute Challenge website. During September, employees bike to work and log their trips online. The Bicycle Transportation Alliance determines the winning workplaces in each category. Individual cyclists who make seven or more trips by bike in September get a discount at their local bike shop.

Participants In 2006 there were 6,186 participating riders from 550 workplaces. The participants made 66,959 trips by bike and rode 627,938 miles.

Additional Information More information on the Commuter Challenge program can be obtained from the Bike Commute Challenge website, <http://www.bikecommutechallenge.com/Oregon>.

Thurston County, WA - Thurston Bicycle Commuter Contest

Program Type The Thurston Bicycle Commuter Contest included the following Conserve by Bicycle evaluation elements:

Education and marketing

Partnerships

Location This program was conducted in Thurston County, Washington.

Description. (from

<http://www.intercitytransit.com/files/9/bicycle%20commuter%20contest%202006%20final%20report.pdf>)

Intercity Transit coordinates the annual Thurston Bicycle Commuter Contest. This contest is held every May and challenges riders of all ages and abilities to maximize bike travel to work, school, and other errands. The 19th annual contest, held in May 2006, was supported by the Capital Bicycling Club, the Washington State Department of General Administration, the Washington State DOT, and close to 50 local businesses. Prizes were awarded to the veteran and first-time participants who rode the most miles or most days, and everyone who returned mileage logs received coupons donated by local businesses.

Unlike a one-day or “Bike to Work Week” event, the month-long duration allowed sufficient time for participants to develop new commuting habits that last throughout the year, promoting healthy transportation for people of all ages and abilities. In addition to awarding prizes, the contest compiled feedback from riders to identify improvements that will increase cycling access and safety in the region.

Program Activities (from

<http://www.intercitytransit.com/files/9/bicycle%20commuter%20contest%202006%20final%20report.pdf>)

The Cities of Olympia, Lacey, Tumwater, and Yelm, as well as the Thurston County Commisisoners, issued declarations announcing May as “Bike Commuter Month.” They encouraged all residents to reduce single occupant motor vehicle trips and try bike commuting.

Earth Day Market Ride The 1st Annual Earth Day Market Ride took place on Saturday, April 22, 2006. Veteran bike commuters converged at Heritage Park in downtown Olympia. After a group photo, they headed to the Farmer’s Market where volunteers signed up participants.

The idea for the event came from volunteers who wanted to create a leisure-paced social ride accessible to new riders. The ride honored Earth Day by showing support for alternative transportation as well as encouraging healthy lifestyle choices.

KAOS 89.3 FM Promotion Veteran bike commuter Rip Heminway went live on a local radio station, KAOS 89.3 FM, to share his riding experiences and promote the contest. He discussed the details of getting started and planning trips around town.

The Wrencher’s Ball This bike safety check and adjustment event has consistently been the biggest draw of the contest. On the last Friday before May, volunteer bike mechanics worked in five shifts at the Olympia Transit Center to inspect and adjust nearly 100 bikes belonging to contest participants.

Rider Feedback Along with reporting their mileage, riders suggest improvements to increase cycling safety and accessibility. In some cases, they describe problem areas on specific roads or intersections. Others contribute more general feedback, such as adding bike parking or creating more bike lanes on roadways. This feedback is a unique resource to city and county planners interested in building more bike-friendly communities.

Participants A near-record 889 cyclists participated in 2006 (Figure 4-14). They rode more than 68,000 miles, an average of 129 miles and 14 days per person. Through this effort, the cyclists saved more than 3,000 gallons of gas and prevented the release of more than 42 tons of carbon dioxide.

BCC Participation History - Thurston County, WA

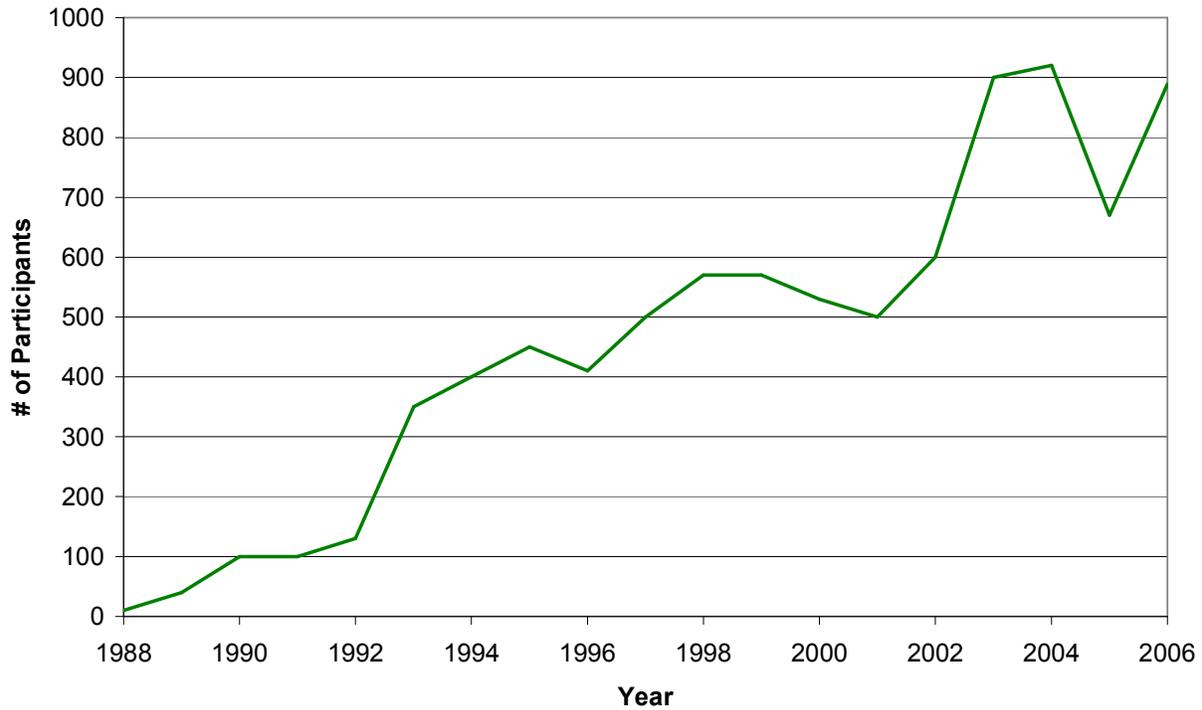


Figure 4-14 Participants in Thurston County Bicycle Commuter Contest
(Source: Intercity Transit)

Two-thirds of the participants were members of workplace-, household-, or school-based teams that ranged in size from 2 to 50 members. The largest workplace teams were the Washington State Department of Ecology, the City of Olympia, the Washington State DOT, and Intercity Transit.

More than half of the 889 cyclists were new participants.

Additional Information More information on the Thurston County Bicycle Commuter Contest can be obtained from the following sources:

- <http://www.intercitytransit.com/page.cfm?ID=0350>

- *Bicycle Commuter Contest 2006 Final Report*. Available online at <http://www.intercitytransit.com/files/9/bicycle%20commuter%20contest%202006%20final%20report.pdf>



South Florida Commuter Services

Program Type The South Florida Commuter Services program included the following Conserve by Bicycle evaluation elements:

Education and marketing

Partnerships

Location The South Florida Commuter Services program was implemented in Boca Raton and West Palm Beach, FL.

Description South Florida Commuter Services (SFCS) is FDOT’s regional commuter assistance program covering Broward, Miami-Dade, and Palm Beach Counties. In May 2006, SFCS partnered with the City of Boca Raton to hold “Bikeopolis,” and with the City of West Palm Beach to hold Bike to Work Week.

Program Activities The project consisted of the following activities:

Boca Raton

Trivia and Essay Contests Participants were invited to enter a trivia contest; those who correctly answered trivia questions were eligible to win gift certificates. Participants could also enter an essay contest on “How Biking Can Improve Your Life”; the prizes were one adult and one youth bike, donated by Bike America.

Safety Safari The Safety Safari included a bicycle rodeo and pedestrian safety obstacle course, bicycle helmet distribution, Police Department open house, children's fingerprinting, child passenger safety and booster seat awareness, police officer presentations, food, and drink.

West Palm Beach Participants were invited to enter a trivia contest; those who correctly answered trivia questions about bicycling laws and safety were eligible to win prizes (Figure N-17 in Appendix N). Bike to Work Week was also publicized at a booth at Clematis Night, a weekly outdoor concert series in downtown West Palm Beach, on Thursday, May 11, 2006.

Participants The people participating in the program included the following.

Boca Raton Forty-six bicyclists participated in Boca Raton. Follow-up surveys showed that 11 were still biking at least two times per week after three months.

West Palm Beach One hundred twenty-five bicyclists participated in West Palm Beach. Follow-up surveys showed that 24 were still biking at least two times per week after three months.

Additional Information More information about South Florida Commuter Services can be obtained from the following sources:

- Jim Udvardy, Project Director, South Florida Commuter Services, 954-731-0062
- Boca Raton Bikeopolis website, <http://www.1800234ride.com/bikeopolis/>
- West Palm Beach Bike to Work Week website, <http://www.1800234ride.com/wpbtmi/>



Hillsborough and Pinellas Counties, FL – Tampa BayCycle

Program Type Tampa BayCycle includes the following Conserve by Bicycle evaluation elements:

Education and Marketing

Partnerships

Location This program is being implemented in Hillsborough and Pinellas Counties, Florida.

Description (from the Tampa BayCycle website at www.tampabaycycle.com)

Sponsored by the New North Transportation Alliance and the Tampa Downtown Partnership, Tampa BayCycle is a movement to promote bicycling to work, school or play. Tampa BayCycle brings together people who believe that riding a bicycle benefits everyone from individuals to the entire Tampa Bay Community. Tampa BayCycle has established the 2007 Bicycle Commuter Challenge during the month of May.

Program Activities Both individuals and businesses can compete in the Bicycle Commuter Challenge. Participants have been recruited through use of incentives and publicity through radio, television and newspaper. Participants are ranked based upon miles logged, days ridden and number of participants. Winners receive bicycle safety equipment from local bicycle shop event sponsors. Registrants provide information including employer, home address, gender, age, one-way commuting distance, and regular commuting mode. Participants access the GoLog web page to log trips by mode, number of trips, and total miles logged by individuals and by organizations. This is self-reported data.

The Tampa BayCycle web site also features links to bikes on buses web pages of transit agencies, registration information for Bay Area Commuter Services free Emergency Ride Home program, links to web sites providing bicycle safety information, and links to local bicycle clubs. Tampa BayCycle also has offered Bicycle Street Skills courses.

Partnerships: Tampa BayCycle received funding sponsorship from FDOT, BACS, AAA, Carrollwood Bicycle Emporium, Oliver's Cycle Sports, Trek, and Bicycle Outfitters. Other

partners include Pinellas Suncoast Transit Authority, Hillsborough MPO, City of Clearwater, YMCA, Tampa's Ross J. Ferlita Greenways and Trails System, FMoPA, Lenny's Sub Shop, and Splittsville Bowling Billiards and Dinner Lounge.

Participants Participants can sign up as part of the Elite 100, who are those that recruit five additional participants. As of May 11, there were 119 persons who signed up as members of the Elite 100 and 183 persons who signed up as members of the 1,001 Friends of Cycling. The Friends are people who were referred to the event by 43 members of the Elite 100. As of May 11, there were 157 registered participants and 16 organizations that had logged bicycling miles.

Additional Information More information can be obtained from the following sources:

- Julie Bond, Executive Director, New North Transportation Alliance, (813) 974-9799
- Karen Kress, Director of Transportation & Planning, Tampa Downtown Partnership, (813) 221-3686
- Tampa BayCycle website, www.tampabaycycle.com



Tampa-St. Petersburg, FL - Bay Area Commuter Services

Program Type The Bay Area Commuter Service includes the following Conserve by Bicycle evaluation element:

Education and marketing

Location This program is being implemented in Hillsborough, Pinellas, Pasco, Hernando, and Citrus Counties, Florida.

Description (from <http://www.tampabayrideshare.org>)

Bay Area Commuter Services, Inc. (BACS) is one of the Florida Department of Transportation's nine commuter assistance programs within the state. It is a private, non-profit organization founded and funded by the State of Florida Department of Transportation to promote transportation alternatives to the single-occupant vehicle in the Tampa Bay area and surrounding counties.

Program Activities Activities pertaining to bicycle commuting are bicycle pools (Figure N-18 in Appendix N) and Emergency Ride Home. The latter is available to registered commuters who bike, walk, ride the bus, carpool, or vanpool at least two days per week and pays for a commuter's ride home in case of personal or family emergency, unscheduled overtime, illness, or carpool/vanpool partners have an emergency.

Participants At the end of 2006, 45 bicyclists were registered with Bay Area Commuter Services.

Additional Information More information about Bay Area Commuter Services can be obtained from the following sources:

- Sandi Moody, Executive Director, Bay Area Commuter Services, (813) 282-8200
- Bay Area Commuter Services website, <http://www.tampabayrideshare.org/>



Education and Marketing Programs – Phase I Study Evaluation

Of the education and marketing programs that were reviewed, the following provided data on energy savings:

- Portland, Oregon: SmartTrips Northeast
 - 988,000 gallons of gas per year (at \$3.00 per gallon, translates into nearly \$2,964,000 in energy savings)
- Thurston County, Washington: Bicycle Commuter Contest
 - 3,000 gallons of gas over the one-month duration of the contest (\$9,000 in energy savings)

Some programs did not specifically provide data on energy savings, but included data on reductions in vehicle miles traveled, from which energy savings can be calculated:

- Portland, Oregon: Bicycle Commuter Challenge – 627,938 vehicle miles reduced during the year 2006 (at one gallon saved for every 20 vehicle miles not driven, translates into \$94,000 in energy savings)
- Greeley, Colorado: Commuter Bicycle Club
 - 2002 – 11,360 vehicle miles reduced (nearly \$2,000 in energy savings)
 - 2003 – 29,434 vehicle miles reduced (over \$4,000 in energy savings)
 - 2004 – 38,933 vehicle miles reduced (nearly \$6,000 in energy savings)

Although no programs specifically provided data on health benefits, several commuter programs and contests provided data on the number of participants. Assuming that the participants were not physically active previously and that they remained physically active after the contests ended, the health benefits per year can be calculated:

- Greeley, Colorado: Commuter Bicycle Club
 - 2002 – 45 participants (nearly \$6,000 in health benefits)
 - 2003 – 60 participants (nearly \$8,000 in health benefits)
 - 2004 – 73 participants (over \$9,000 in health benefits)
- Fort Collins, Colorado: Commuter Coach
 - 1st year – 100 participants (nearly \$13,000 in health benefits)
 - 2nd year – 250 participants (\$32,000 in health benefits)
 - 3rd year – 500 participants (\$64,000 in health benefits)

- Portland, Oregon: Bike Commuter Challenge
 - 6,186 participants (nearly \$792,000 in health benefits)
- Thurston County, Washington: Bicycle Commuter Contest
 - 889 participants (nearly \$114,000 in health benefits)
- Boca Raton, Florida
 - 11 participants were still biking at least two times per week after three months (over \$1,000 in health benefits)
- West Palm Beach, Florida
 - 24 participants were still biking at least two times per week after three months (nearly \$3,000 in health benefits)

Other findings include the following:

- Portland, Oregon: Interstate TravelSmart, 2004
 - Bicycling increased from 3% to 5% of all trips.
 - The program contributed to an increase in physical activity of 25 hours per person per year, as a result of more bicycling, walking, and access to/from transit.
- Portland, Oregon: Eastside Hub, 2005
 - Peak-hour bicycle counts showed 23% more bicyclists at the end of the program than at the beginning.
 - Bicycling increased from 4% to 6% of leisure trips.
 - Residents took an average of 1.62 new bicycling trips every week.

These two programs did not provide sufficient data to allow for the calculation of energy savings and health benefits, but the available data are evidence that the programs have increased levels of bicycling in their target populations.

Education and Marketing Programs – Recommendations

To increase the possibility that more people will choose to bicycle, the researchers recommend that education and marketing programs in Florida implement the following activities:

- Incorporate a comprehensive range of program activities that appeal to a wide audience. For example, Portland's TravelSmart and SmartTrips programs provide information about bicycling to residents and employees, conduct group bicycle rides for new and inexperienced riders, distribute bicycle helmets and lights, etc.

- Undertake an extended marketing effort. Portland's programs last for six months. This extended time period allows each program to reach more of its target audience and affords residents an opportunity to change their travel behavior. For programs aimed at commuters, an extended effort lasting several months, or possibly having several bike months throughout the year, may sustain bicyclist interest and participation, and thereby result in greater energy savings and health benefits.
- Select areas that already have good bicycling infrastructure for promotional campaigns. People are more likely ride bicycles if they perceive that it is safe to do so, as when bicycle lanes, shared use paths adjacent to roadways, or independent alignments are present.
- Dedicate paid and volunteer staff. For example, the 2007 SmartTrips Southeast program has budgeted 4.35 FTE staff and 500 hours of volunteer time.
- Conduct before-and-after program evaluations, so that the effects of program activities on the level of bicycling among the target audiences can be observed. While bike-to-work programs can potentially have lasting impacts, few such programs conduct follow-up surveys of participants. Evidence from follow-up surveys in two Florida cities, Boca Raton and West Palm Beach, suggests that about 20% to 25% of program participants are still bicycling three months later.

CHAPTER 5 PARTNERSHIPS

This portion of the Conserve by Bicycle Phase I report evaluates the energy savings and health benefits of partnerships that promote bicycling. Partnerships are components of successful education and marketing programs.

One goal of the Conserve by Bicycle Program Study is to determine:

- *How partnerships can be created among interested parties in the fields of transportation, law enforcement, education, public health, environmental restoration and conservation, parks and recreation, and energy conservation to achieve a better possibility of success for the program.*

The following sections describe the measurable criteria, literature search, research plan, and program evaluations pertaining to partnerships.

Measurable Criteria

A partnership program results in energy savings and health benefits if the implementation of that program results in the outcome that an individual who would otherwise have driven a car now chooses to ride a bicycle. Consequently, mode shift was chosen as the measurable criterion for partnership programs.

Literature Search

As with the other focus areas, a literature search was conducted to determine what partnership programs to promote bicycling had been implemented in Florida and across the United States. The researchers were specifically looking for programs that could document a mode shift; however, no such programs were found in Florida. The complete literature search pertaining to partnership programs is contained in Appendix Q of this report.

Research Plan

The literature search found no information related to the effectiveness of partnership programs. To accurately quantify the benefits of these programs, data would need to be collected on programs implemented in the State. The mode shift resulting from partnership programs would be measured using before-and-after surveys of participants and bicycle counts. To evaluate these

programs, a potential program would be identified prior to its being implemented. Bicycle counts or potential participant surveys would be performed in the targeted area to obtain baseline data as part of Phase II of this Study. Supplemental data would be collected several months after program implementation to identify how many individuals have shifted to bicycling as a travel mode for utilitarian trips. Additional insight into increases in bicycling could be obtained by counting bicycles in bicycle parking facilities located in the targeted areas.

Program Evaluations

The researchers reviewed several partnerships that focused on bicycle giveaways

1. God's Pedal Power Ministry (Tampa, FL)
2. Sibley Bike Depot (St. Paul, MN)
3. "Earn a Bike" (assorted California cities)
4. Create a Commuter (Portland, OR)

These are all bicycle giveaway programs, through which individuals in need may qualify to receive a bicycle. Although none of them provided data on energy savings and improved public health, the bicycle giveaway programs did provide data on the number of bicycles distributed annually, which ranges from a few dozen to a few hundred. However, none of them conducted follow-up studies of how often or for what purposes individuals were riding their bicycles.

The researchers also reviewed programs that are predominantly education and marketing but include a strong partnership element with regard to energy savings and improved public health. These programs are discussed in the "Education and Marketing" section of this Phase I Final Report.

Detailed program descriptions are provided below.

Tampa, FL – God's Pedal Power Ministry

Program Type God's Pedal Power Ministry includes the following Conserve by Bicycle evaluation element:

Partnerships

Location God's Pedal Power Ministry is in Tampa, Florida.

Description God's Pedal Power Ministry refurbishes and gives away bicycles to adults and children in need.

Program Activities God's Pedal Power is a ministry, run by volunteers, that gives away donated bikes several times a year. Individuals who would like to receive a bike must complete an application form. Those who are selected to receive a bike must attend a bike safety class and a Bible study class on the day of the giveaway. In addition to the bike, recipients also receive a helmet and a Bible. The ministry also repairs bikes for individuals in need.

Participants God's Pedal Power has given away over 3,000 bikes since 1997.

Additional Information More information on God's Pedal Power can be obtained from the following source:

God's Pedal Power website, <http://www.godspedalpower.org>



St. Paul, MN – Sibley Bike Depot

Program Type The Sibley Bike Depot includes the following Conserve by Bicycle evaluation elements:

Partnerships

Education and marketing

Location The Sibley Bike Depot is in St. Paul, MN.

Description The Sibley Bike Depot is a non-profit, membership-based biking and walking organization in St. Paul, MN. It helps new bicyclists through advocacy, classes, and a community education, repair, and retail facility.

Program Activities The Sibley Bike Depot repairs donated bicycles and gives them to persons who could not otherwise afford them. It also conducts commuter seminars and operates an online discussion forum.

Participants The Sibley Bike Depot gives away hundreds of bikes every year.

Additional Information More information on the Sibley Bike Depot can be obtained from the following source:

Sibley Bike Depot website, <http://www.bikeped.org>



California – “Earn a Bike” Programs

Program Type The “Earn a Bike” programs included the following Conserve by Bicycle evaluation elements:

Partnerships

Education and marketing

Location The “Earn a Bike” programs were conducted in different cities around California, as stated below.

Description The Bicycle Head Injury Prevention Program of the California Department of Health Services compiled information about "Earn a Bike" programs in California in 2000. Details about specific programs are given below.

Program Activities and Participants

Adopt-a-Bike Program, San Bernardino This program was founded in 1991 and serves as a community-based organization serving youth. Bicycles are donated by the San Bernardino and Rialto police departments, Costco, and the community.

Partners are the County Board of Supervisors, San Bernardino Sun News, Costco, John Morgan Framing Company, Rene J. Jacober (attorney), Kiwanis, and Loma Linda Medical Center. In addition, bicycle parts are furnished by Children's Fund of San Bernardino.

In 1997, the budget was \$85,000 for rent, utilities, salaries, tools, parts, tires, metal paint, insurance, and operating expenses for a truck that picks up bikes. The CEO volunteers his time, and repair work is done by people required to complete community service.

To earn a bicycle, youth have to:

- Write a two-page autobiography answering the question, "Why are you special?"
- Read four books at grade level
- Verbal interview with program CEO discussing the autobiography and the four books
- Learn the parts of the bicycle and how to assemble them
- Pass a 40-item safety quiz
- Sign pledge to always wear helmet and to maintain the bike

The youth then selects and repairs a bicycle that will be his/her own.

As of December 1997, youth earned 1,161 bikes. An additional 1,000 bikes had been donated to other youth programs such as Toys for Tots and Community Services. The program issued over 1,400 helmets, free of charge.

Pedal Power, San Francisco Pedal Power was started in 1993 by a local bicycle advocate with a \$5,000 grant from the McKesson Foundation. This program serves at risk youth ages 7-17 through mentoring and training. Bicycles are donated by individuals, the police department, and Trips for Kids surplus.

Partners are the Tides Center, San Francisco Conservation Corps, Western Addition Health and Wellness Collaborative, Booker T. Washington Community Center, and Ella Hill Hutch Community Center.

In 1997, the budget was \$82,000, which paid salaries, rent, utilities, internships, and tools. Parts and supplies are donated.

To receive a bicycle, youth have to earn \$50 in “bike bucks” through participation, completing classes, and bike repair. Youth spend a minimum of 15-20 hours in the Bike Traffic Training program, which includes safety, basic bicycle mechanics, and on-road skills. Youth 15 and older may advance to the Bike Traffic Corps, where they receive advanced training and additional mentoring, and where they serve as mentors for youth in the Bike Traffic Training program.

As of October 2001, 560 bikes and helmets had been distributed.

Richmond PAL Program This started as an informal program of the Richmond Fire Department, which had been repairing bikes for youth as rewards for behavior and excellence in sports. The formal program developed through a grant of \$10,000 from the San Francisco Foundation and another grant of \$10,000 from the California Department of Health. Bicycles come from local police departments and community donations.

Partners are Home Depot, Albany Steel Warehouse, Richmond, San Pablo, and El Cerrito Police Departments, and ACE Hardware. In addition, the school district loaned facility space.

The budget in 1997 was \$12,000 for salary and \$8,000 for building materials, facility repair security measures, and computer supplies. The coordinator volunteers part of his time, and other volunteers assist.

To earn a bicycle, youth must complete a basic mechanical curriculum, thereby earning points toward the purchase of a bicycle. Youth are also required to earn or purchase a helmet.

As of December 1997, over 100 bicycles had been distributed.

Blast Earn-A-Bike Program, Woodland Hills Blast is an offshoot of a bicycle safety program for all middle and high schools in the Los Angeles Unified School District. Bicycles come from Los Angeles Probation Department and donations.

Partners include the Automobile Club of Southern California, City of Los Angeles Department of Transportation, MTA, Los Angeles Police Department, Los Angeles Unified School District School Police, City of Los Angeles, Los Angeles County Hospitals, and Boys and Girls Clubs.

The annual budget ranges from \$100,000 to \$250,000 depending on transportation grant funding.

To earn a bicycle youth must complete either a certain number of rides or an accumulation of miles. In addition each school decides on requirements, but the program emphasizes at least a C average, commitment to the club, obeying traffic laws, wearing a helmet, and bicycle registration.

From May 1998 to May 1999, youth earned over 600 bicycles. Over 8,000 helmets have been distributed.

Bikes 90800, Long Beach Bikes 90800 is provided by the North Long Beach Future Generations Youth Center. Partners are the Park & Recreation Department, Police Department, and Jax Bicycle Shop. Bicycles come from community donations.

In 1997, the budget was \$550, for tools, parts, tires, and paint. The program coordinator serves on a volunteer basis, as does an assistant. Non-violent, non-drug offenders from a local halfway house assist to complete their community service hours.

To earn a bicycle, youth complete a 16-hour course, learning to work on their bikes and about bike safety.

As of December 1997, youth earned approximately 100 bicycles.

Earn a Bike Program, Oakland This program was developed for low income youth 9-18. Bicycles come from police impound and community donations.

Partners are the Police Department, Target Stores, Channel 13, Oakland Unified Schools, Oakland Fire Department, Oakland Police Department, and Kaiser.

For 1997, the budget was \$24,000 for part time staff and \$9,000 for parts, supplies, and computer materials. The program uses space in a city-owned building.

To earn a bicycle, youth complete 40 hours of community service, learn bike maintenance, bike safety, helmet use, pass a safety test, pledge to wear a helmet and practice safe cycling.

Youth have earned over 800 bicycles. If more bicycles were available, the program could provide bikes for an additional 500 youth annually. When possible, helmets are provided by the program.

Learn to Earn Program, Ontario This program allows youth to earn a bike. Bicycles come from police inventory.

Partners are the Police and Recreation Departments and Bumstead's Bicycle Shop.

To enter the program, youth must write an essay on "Why I Want a Bike." They must show a positive attitude, sign a pledge form, and have their parents sign a release form. To earn a bicycle, youth must earn 100 community service points by performing tasks such as cleaning up after special events and helping other youth with homework. Youth must also complete a one hour class in bicycle safety and license their bike.

As of December 1997, four bicycles had been distributed and 12 youth are currently working towards their bikes. The program also gives helmets.

Santa Barbara Bicycle Project This project was started in 1996 by the Santa Barbara Bicycle Coalition in collaboration with Girls Incorporated of Greater Santa Barbara. Bicycles come from police inventory.

Other partners are Jandd Mountaineering, local bike shops, and Santa Barbara Rescue Mission Program. Bicycles come from community donations, bike shop rejects, abandoned bikes, property owners, and the Santa Barbara Middle School Bike Program. Troxel Inc. provided helmets at a discounted price.

The project receives \$700 per year for parts and materials. Incentive items are purchased with funds raised from bike sales.

To earn a bicycle, youth complete an eight-week curriculum and 50 hours of shop service. They participate in three group rides, pass a bicycle mechanics and safety exam, and complete one community service activity.

Between January 1997 and January 2000, about 200 youth earned bikes.

Trips for Kids, Mill Valley Trips for Kids is a non-profit organization that provides mountain bike outings and after-school biking programs for inner city youth ages 10-17. Trips for Kids operates a bike thrift shop and an Earn-A-Bike program. Youth over 14 years old are trained for jobs at the thrift shop or other bike shops.

The budget for the year 2000 was \$236,000. The biggest sources of funding are thrift shop sales (48%) and grants (32%). The staff numbers 10 adults and 6 teens.

To earn a bicycle, youth commit to 25 hours of work and earn credits towards a bike or parts by completing a curriculum on basic mechanic skills, bike safety, environmental awareness, and community service.

Each year at least 75 youth earn enough credits for a bike. Since many of them have their own bikes, they use the credits for parts or a computer. The thrift shop sells about 1,000 bikes annually. Trips for Kids distributes about 1,200 bikes to other non-profit programs in the area.

Additional Information

More information about California's "Earn a Bike" programs can be obtained from the following source:

Valodi Foster, (916) 324-3286

Portland, OR – Community Cycling Center

Program Type Portland's Community Cycling Center includes the following Conserve by Bicycle evaluation elements:

Partnerships

Education and marketing

Location This program is being conducted in Portland, Oregon.

Description (<http://www.communitycyclingcenter.org/about.html>)

The Community Cycling Center was founded in 1994 with a mission of building skills and fostering the personal growth of youth through community-oriented recreational and educational bicycle programs and services.

Program Activities (from <http://www.communitycyclingcenter.org/create-a-commuter.html>)

Create a Commuter The Community Cycling Center's Create a Commuter program provides low-income adults with fully-outfitted commuter bicycles and five hours of training on safe bicycle commuting.

In order to qualify as a Create a Commuter recipient, an individual must be referred through a social service agency that can verify income and other eligibility requirements. Once the referral is made, the average wait to be scheduled for a bicycle is 2-3 months.

Partners include Adult & Family Services, Common Bond, Better People, Cascade AIDS Project, Heart of the Family, International Refugee Center of Oregon, SMS Services, JOIN, Multnomah County Behavioral Health, and many other agencies and providers.

Create a Commuter is funded by a grant from the federal Job Access initiative and is funded by TriMet.

Participants Around 850 people apply to the program every year; Create a Commuter is able to assist about 375 of them.

Participants use their bikes for errands (64%), work (62%), recreation (45%), to improve health (45%), to visit friends (30%), and to attend appointments (23%).

Additional Information More information on Portland's Community Cycling Center is available from the following source:

Community Cycling Center website, <http://www.communitycyclingcenter.org/about.html>



Partnerships – Recommendations

To increase the possibility that more people will choose to bicycle, the researchers recommend that partnership programs in Florida implement the following activities:

- Incorporate a comprehensive range of program activities that appeal to a wide audience. For example, Portland's TravelSmart and SmartTrips programs provide information about bicycling to residents and employees, conduct group bicycle rides for new and inexperienced riders, distribute bicycle helmets and lights, etc.
- Create and maintain multiple partnerships. The additional resources (such as dollars, staffing, and incentives) that partners bring can serve to expand the scope of program

activities. Partners may include local government agencies, businesses, hospitals, media, and non-profit organizations, to name a few.

- Dedicate paid and volunteer staff. For example, the 2007 SmartTrips Southeast program has budgeted 4.35 FTE staff and 500 hours of volunteer time.
- Conduct before-and-after program evaluations, so that the effects of program activities on the level of bicycling among the target audience can be observed. These data are needed to calculate energy savings and health benefits.

CHAPTER 6 PUBLIC INVOLVEMENT

Steering Committee

As specified in the scope, a Steering Committee was assembled, consisting of the State Pedestrian/Bicycle Coordinator and other FDOT staff, as well as representatives from the Department of Environmental Protection, the Department of Community Affairs, MPOs, and other agencies and organizations.

The Steering Committee and the consultant team met four times:

July 13, 2006	FDOT Central Office, Tallahassee
October 17, 2006	FDOT District 4, Fort Lauderdale
March 7, 2007	Volusia County MPO, Daytona Beach
May 16, 2007	FDOT District 7, Tampa

At each meeting, the researchers updated members of the Steering Committee as to progress. The Steering Committee offered many valuable suggestions.

Public Survey

As noted in Chapter 2, “Provision of Bicycle Facilities,” several key pieces of information, including average utilitarian trip length and average recreational trip length, were used to calculate the energy savings and health benefits resulting from the construction of bicycle facilities. A public internet survey was developed and conducted to obtain specific data pertaining to these average trip lengths.

An invitation to participate in the survey and the website address for the survey were sent to persons on e-mail lists maintained by the State Pedestrian/Bicycle Coordinator and by the Florida Bicycle Association. The survey was completed by 1,258 participants.

Table 6-1 shows how often and how far participants rode by facility type and trip purpose. The number of responses may exceed the number of survey participants (1,258) because participants had the option of answering questions for up to four shared use paths, four shared use paths adjacent to roadways, and two on-street facilities.

Table 6-1 Frequency and Distance Ridden by Bicyclists

Facility Type and Trip Purpose	Average Number of Times per Year	Average Distance Ridden (miles) ¹	Number of Responses
Shared Use Path – Recreational	26.80	27.81	2,134
Shared Use Path – Utilitarian	5.04	10.56	2,107
Shared Use Path Adjacent to Roadway – Recreational	46.98	22.89	1,056
Shared Use Path Adjacent to Roadway – Utilitarian	18.58	7.81	1,033
On-street facility – Recreational	56.34	26.13	1,151
On-street facility - Utilitarian	25.41	7.56	1,134

¹ For recreational trips, the average distance ridden is the average total distance ridden on that facility. It is a round-trip distance if the bicyclist returned to his/her origin on the same facility. It is a one-way distance if the bicyclist rode on the facility as part of a loop ride. For utilitarian trips, the average distance ridden is the average one-way distance ridden on that facility.

The participants in this Conserve by Bicycle Program Study survey were likely to be more avid cyclists than those who responded to a 2002 phone survey conducted by the Center for Urban Transportation Research.⁴⁹ Therefore, the average utilitarian trip lengths are longer than those found in the 2002 phone survey.

⁴⁹ Center for Urban Transportation Research. *Bicycle and Pedestrian Travel: Exploration of Collision Exposure in Florida*. University of South Florida, Tampa, FL, 2002.

CHAPTER 7 PHASE I STUDY FINDINGS AND RECOMMENDED PHASE I IMPLEMENTATION PLAN

The provision of bicycle facilities and the promotion of bicycling through programs and/or partnerships can increase the number of people riding bikes in Florida. The mode shift and induced recreational travel models developed in this first phase of the Study confirm that more people will ride bicycles when bicycle facilities are built. The extent of this is dependent on the length and quality of the facility provided, the extent of the surrounding bicycle network, the surrounding population and employment mix and density, and several other factors. Thus, energy savings and health benefits vary with the bicycle facility type and surrounding demographic environment. Phase I study analysis of programs and partnerships indicates, based primarily on evidence of programs outside the State, that properly targeted and funded programs and/or partnerships with human behavior change incentives are effective in influencing a mode shift from auto to the bicycle mode of travel and/or increased recreation/exercise via bicycling activity.

The Phase I literature searches, data collection, analytical modeling and evaluations reveal that an implementation plan for the State of Florida will bring about significant energy savings and public health improvement to Floridians. This implementation plan should choreograph 1) bicycle facilities construction, with 2) improving the existing transportation network's bicycling accommodation, and strongly link those actions with 3) effective bicycle travel activity encouragement and incentive programs. While the Florida-based data available for this Phase I Study are somewhat weak as to what constitutes an effective encouragement/incentive program for Florida, effectiveness data from other programs throughout the United States provide excellent direction for the Phase II data collection, research and evaluation.

Outlined below are the *integrated* findings and recommendations for the Implementation Plan based upon what we do know conclusively from Phase I of this Study. Recommendations for the Phase II study efforts are interspersed.

Provision of Bicycling Facilities

Each bicycle facility that is added to the bicycling network within the State has the potential to increase the number of trips people make by the bicycle mode. As discovered in the mode shift

modeling effort of this first phase of the Study, however, improving the bicycling accommodation in the transportation network surrounding a single facility provision adds much to the mode shift in that facility's travel corridor. This linkage is important and the results are pronounced – improvement throughout the whole network provides a greater benefit than the sum of the parts (streets). Systemwide improvements should be included in funding, planning, design and construction programs.

The expressed attitudes of Floridians reflect this analytical finding. Many people say that “they would bike (and walk) for exercise more if good facilities were conveniently located.”⁵⁰ This suggests that continuing to build bicycle facilities throughout Florida will result in increasing the number of people who ride bikes for exercise (and for utilitarian purposes). The Statewide surveys performed in 1998 and 2002, shortly after bike lanes became the standard FDOT roadway treatment for bicycles, indicate a growth in the percentage of respondents using bikes (and the length of their bicycle trips).

Construction of Bicycle Facilities on Roadways

It is recommended public agencies accommodate bicycling on all roadways in Florida.

Specifically, the following should be done:

1. Retain the current FDOT policy to provide bike lanes or paved shoulders on road construction (new or reconstruction) projects on state roads.
2. Ensure bike shoulders, lanes, and/or shared use pathway inclusion on all (non-limited access) new bridge construction or reconstruction projects.
3. In constrained rights of way, consideration should be given to narrowing travel lanes from 12 (to 10 feet, in some limited cases – speeds < 40 mph and little truck traffic) to make room for paved shoulders or bicycle lanes. Research has shown travel lane width

⁵⁰ Eighty percent of people agreed with this statement (Berman, Evan. *Bicycling and Walking Attitudes Survey District 5*, University of Central Florida, Orlando FL, 2003).

to have little or no effect on capacity for motor vehicles.^{51, 52, 53} (A summary of this research is included as Appendix P of this report.)

4. Consider the use of shared use paths along roadways where there are minimal driveway/side street conflicts. As with the Suncoast Parkway Trail in west central Florida, this should include pathways along limited access arterials such as expressways. This can be particularly important as these high level facilities are sometimes the only practical route across geographic barriers such as rivers or wetlands, or across rural parts of the state. When installing shared use paths adjacent to roadways, special care must be taken to ensure that at every conflict point all users (motorists and path users) understand their responsibilities at the conflict points, and be given adequate notice of the conflict and time to act appropriately. National and state guidance documents, including the FDOT District 1 Sidepath Study, should be carefully consulted when planning and designing these facilities.

Responsible Agencies The Florida Department of Transportation would be the lead agency for implementing these strategies. Actions number 1 and number 2 require only that FDOT maintain and continue to implement their current design policies. FDOT already provides for action number 3 in its *Plans Preparation Manual* chapter on Transportation Design for Livable Communities. The Florida *Greenbook*⁵⁴ which represents the adopted standards for all non-DOT roadways in Florida does not provide an option for reducing lane widths on collectors and arterials to 10 feet; FDOT can present this recommendation to the Florida *Greenbook Committee* for their consideration. Action number 4 would include additional research to identify how

⁵¹ Potts, I.B., *et al.* Relationship of Lane Width to Saturation Flow Rate on Urban and Suburban Signalized Intersection Approaches. Presented at the 2007 Annual Meeting of the Transportation Research Board, Washington, DC.

⁵² Zegeer, J.D. Field Validation of Intersection Capacity Factors. *Transportation Research Record 1091*. Transportation Research Board, Washington, DC, 1986.

⁵³ Agent, K.R. and J.D. Crabtree. *Analysis of Saturation Flow at Signalized Intersections*. Kentucky Transportation Research Program, University of Kentucky, 1983.

⁵⁴ FDOT *Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways*, Tallahassee, FL May 2005.

bicyclists perceive shared use paths adjacent to roadways as compared to on-street facilities and to refine the District 1 study into more specific design criteria (see also recommended work plan for Phase II of the Conserve by Bicycle Program Study).

Require Recreational Infrastructure in New Developments

This Phase I Study research has shown that provision of bicycle facilities will increase the number of people among the nearby population who achieve the level of physical activity recommended by the national Center for Disease Control. Therefore, it is recommended that the State of Florida mandate via growth management provisions the inclusion of infrastructure in all new residential developments adequate to allow residents of all ability levels to reach their recommended levels of physical activity (30 minutes of moderate activity on 5 days of each week). Shared use pathways are examples of such infrastructure and are highly recommended as strategies to fulfill this requirement. These facilities cost effectively provide opportunities for numerous forms of exercise—biking, walking, in-line skating, etc.—that have relatively low cost thresholds for participation and are therefore available to a broad range of the population.

Responsible Agencies The Florida Department of Community Affairs would lead this effort in making recommending changes to enabling State legislation.

Build New Multi-Use Paths, Especially in Scenic Areas and Near Population Centers

This Phase I study research has shown that provision of bicycling facilities for recreation/exercise, such as shared use pathways, will result in increased levels of physical activity and therefore provide measurable public health benefits. Research has also shown that shared use pathways will attract more users if they are situated near areas of higher population and/or if they are situated in scenic or aesthetically pleasing environments (Figure 7-1).

Therefore, it is recommended that the State fund the development of shared use pathways with special emphasis on areas of scenic interest and/or near population centers.



Figure 7-1 A shared use pathway in a scenic environment

Responsible Agencies The Florida Department of Environmental Protection, through the Office of Greenways and Trails and Division of Recreation and Parks would lead this effort. Through the State Comprehensive Outdoor Recreation Plan and park planning efforts, these entities could prioritize pathway projects in areas that would most benefit from their implementation. The Florida Department of Transportation could also promote this effort through recommended selection criteria for enhancement projects.

Improving the Existing Transportation Network to Better Accommodate Bicycling

Establish Minimum Standards for Bicycle Accommodation on Roadways

The technical evidence is clear from the Phase I portion of this Study; bicycling activity is concomitant with increasing provision of bicycle facilities: shoulders, bike lanes, shared use paths in roadways, and shared use paths in separate rights-of-way. Provision of bicycle facilities can be measured and monitored through the adoption of minimum Bicycle Level of Service standards, and tailored to situational specifics such as roadway functional class and urbanized or non-urbanized location. These standards should be applied to new and reconstruction of roadways and bridges through FDOT regulations, land development concurrency provisions and

physical development codes, and local governments' roadway and bridge facility design standards.

Responsible Agencies The Florida Department of Community Affairs would lead this effort. Working with the Florida Department of Transportation, they would recommend changes to enabling legislation to promote this action.

Retrofit the Existing Roadway and Street System

The above Level of Service standards should also be applied to existing roadways, and those not meeting the standard should be retro-fit, with the most cost-effective way to accomplish this being the re-striping during roadway resurfacing to include bike lanes or shoulders where adequate pavement is available. Roadway re-striping is a relatively simple and inexpensive way to better accommodate bicyclists. Re-striping is frequently performed coincidentally with resurfacing projects, which present a window of opportunity to re-allocate pavement for bicyclists. Candidate roadways and streets have outside lane widths that suggest the possibility of re-striping for at least a three-foot wide shoulder and either an eleven-foot or twelve-foot wide travel lane on the roadway, depending on the posted speed limit: eleven feet for speeds 45 mph or lower, twelve feet for those higher. In specific locations, outside lane widths of 10 feet should also be considered to help reach the desired accommodation level (LOS), assuming a small amount of truck traffic exists. These locations include local roads⁵⁵ or on roadway projects implementing Transportation for Livable Design⁵⁶ criteria where the posted speed is lower than 35 mph and there is little truck traffic.

These minimum recommended widths for motor vehicle travel lanes are based on the 2004 AASHTO *Policy on Geometric Design of Highways and Streets*. The AASHTO *Policy* states in its foreword that its intent is to recommend “range of values for critical dimensions.” These ranges allow for flexibility, as the *Policy* describes:

⁵⁵ FDOT. *Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways*. Florida Department of Transportation, Tallahassee, FL. 2005, p. 3-67.

⁵⁶ FDOT *Plans Preparation Manual*, Florida Department of Transportation, Tallahassee, FL, 2007, p. 21-5.

Minimum values are either given or implied by the lower value in a given range of values. The larger values within the ranges will *normally be used where the social, economic, and environmental impacts are not critical* (emphasis added).⁵⁷

With regard to the width of lanes on Urban Arterials, the *Policy* states:

Lane widths may vary from 10 to 12 ft. Lane widths of 10 ft. may be used in highly restricted areas having little or no truck traffic. Lane widths of 11 ft. are used quite extensively for urban arterial street designs. The 12 ft. lane widths are most desirable and should be used where practical, on higher speed, free flowing, principal arterials.⁵⁸

The *Policy* clarifies further,

Under interrupted-flow operating conditions at low speeds (45mph or less), narrower lane widths are normally adequate and have some advantages.⁵⁹

Additional research performed for the National Cooperative Highway Research Program concludes that the “preferred lane width for urban arterial streets under most circumstances is 11 ft. or 12 ft.” and finds that the use of narrower lanes can lead to “traffic operational benefits, traffic safety benefits, or both.”⁶⁰

On many state roadways and bridges, however, which will have relatively more truck traffic than local roadways, it is not recommended that re-striping to travel lane widths narrower than 12 feet be attempted on roadways with posted speed limits over 45 miles per hour. It is recommended, however, that motor vehicle lanes 11 feet wide be considered on roadways with posted speed limits of 45 miles per hour or less, if re-striping to these dimensions creates

⁵⁷ AASHTO. *A Policy on Geometric Design of Highways and Streets*. American Association of State Highway and Transportation Officials, Washington, DC, 2004, p. xliii.

⁵⁸ AASHTO. *A Policy on Geometric Design of Highways and Streets*. American Association of State Highway and Transportation Officials, Washington, DC, 2004, p. 472.

⁵⁹ AASHTO. *A Policy on Geometric Design of Highways and Streets*. American Association of State Highway and Transportation Officials, Washington, DC, 2004, p. 473.

⁶⁰ Harwood, Douglas H. *National Cooperative Highway Research Program Report 330: Effective Utilization of Street Width on Urban Arterials*, TRB, National Research Council, Washington, D.C., 1990, p. 35.

adequate room for bicyclists, as defined below, and brings the roadway segment into compliance with the adopted level of accommodation (LOS).

When designating dimensions for the re-striping of existing pavement cross-sections to include rideable shoulders, a minimum width of three feet to the outside of the repositioned edge stripe is recommended. Where more than three feet is available, it is recommended that the extra space be provided, but three-foot shoulders have been shown by research and practice to provide a tangible sense of comfort to cyclists.⁶¹ While the 1999 AASHTO *Guide for the Design of Bicycle Facilities* expresses a preference for four-foot wide shoulders for the purposes of signing and marking the facility as a bike lane, it also states, “However, where 4-foot width cannot be achieved, any additional shoulder width is better than none at all.” Research published since the 1999 *Bike Guide* found that the actual width of a bicyclist is approximately 27 inches⁶²; consequently, shoulder widths of less than 3 feet are not recommended.

These re-striping strategies represent opportunities for quickly improving bicycling conditions within a surrounding roadway network by retro-fitting existing roadways, a relatively inexpensive solution. However, re-stripe candidate roadways should always remain under consideration for further improvement in conjunction with new land development, and roadway reconstruction or widening projects that may come to fruition over time.

Responsible Agencies As noted previously, the Florida *Greenbook* which represents the adopted standards for all non-DOT roadways in Florida does not provide an option for reducing lane widths to 10 feet. Again, it is recommended that the Florida Department of Transportation present this recommendation to the Florida *Greenbook Committee* for their consideration.

⁶¹ Landis, Bruce W., Venkat R. Vattikuti, and Michael T. Brannick “Real-Time Human Perceptions: Toward a Bicycle Level of Service” *Transportation Research Record 1578*, Transportation Research Board, Washington DC 1997.

⁶² Landis, B., T. Petritsch, and H.Huang, *Characteristics of Emerging Road and Trail Users and Their Safety*, FHWA-HRT-04-103, McLean, VA, 2004.

Relax Motor Vehicle Level of Service Standards and Increase Bicycle Level of Service Standards in Areas with Mixed Land Use, Especially where Employment and Residential Population Are Dense

This Phase I study research has shown that potential for mode shift from automobile to bicycle is quantifiably enhanced as *Motor Vehicle* Level of Service decreases and bicycle facilities are provided (i.e., Bicycle Level of Service improves). This effect is particularly pronounced in transportation networks serving areas with a mix of higher employment and population density. Therefore it is recommended that Motor Vehicle Level of Service standards be relaxed in such areas and, rather than increasing motor vehicle capacity to maintain such a standard in response to congestion, bicycle accommodation be improved instead.

Responsible Agencies The Florida Department of Community Affairs would lead this effort. Working with the Florida Department of Transportation, they would recommend changes to enabling legislation to promote this action.

Adopt Land Use Policies that Encourage Mixing of Higher-Density Residential and Employment Uses

The Phase I study research also shows clearly that providing bicycle facilities and improving the surrounding transportation network will have an even greater impact in areas with a good mix of high residential and employment densities.

Responsible Agencies The Florida Department of Community Affairs would lead this effort. Working with the Florida Department of Transportation, they would recommend changes to enabling legislation to promote this action.

Continue Research Regarding Provision of End-of-Trip Facilities for Bicyclists

In both the afore-referenced FDOT District 7 research and the Conserve by Bicycle Study Phase I (Task 3, facility provision modeling of mode shift), it was hypothesized that availability of secure bicycle parking (Figure 7-2) and “locker” facilities for showering and changing clothes at

bicycle trip destinations (generally all non-residential land development forms) will increase the level of bicycle use, especially for commuting. Unfortunately, neither project's budget allowed for data collection and testing of this important hypothesis. It is thus recommended that the Phase II study for the Conserve by Bicycle Program explore this issue further to determine the effect of end-of-trip facilities on bicycle usage.

Responsible Agencies The Florida Department of Community Affairs would lead this effort. Working with the Florida Department of Transportation, they would recommend changes to enabling legislation to promote this action.



Figure 7-2 Secure bicycle parking

Bicycle Activity Encouragement & Incentive Programs

The findings of this phase of the Study indicate that encouragement of bicycling activity can be achieved through programs and/or partnerships targeted to distinct populations: school children, commuters, and all groups of people for recreation and exercise activity promotion. The paucity of before-and-after data for existing Florida-based programs provide direction for Phase II study

and evaluation. However, Phase I findings do provide direction for implementing⁶³ programs and partnerships in Florida to achieve energy savings and improved public health through bicycling travel and recreation/exercise activity.

Safe Routes to School

This Phase I evaluation of Safe Routes to Schools programs suggest that a number of approaches need to be taken at Florida schools to increase the number of students riding to school. Evidence could not be found to demonstrate that Florida bicycle traffic safety programs alone increase the amount of students cycling to school (although they may improve the safety of those already riding to school). Facility based or engineering measures will result in improvements for those who are already riding to school and may induce some mode shift from bus or personal vehicle to bicycling. The Phase I data seem to indicate that encouragement or incentive programs, such as contests, events, and promotional materials seem to have a significant impact on bike riding to schools, particularly when combined with the provision of facilities.

Law enforcement is a facet of the Safe Routes to School program that should not be neglected, despite the elusiveness of data in measuring this effect on the Conserve by Bike Program objectives. The perceived (and actual) safety around schools can be improved by enforcing speed limits and laws requiring motorists to yield, as well as ensuring that bicyclists obey traffic laws and do not behave erratically. This would likely result in more parents allowing their students to bicycle to school.

To increase the possibility that more students will ride bicycles to school, Safe Routes to School programs in Florida should implement the following activities:

1. Incorporate education, engineering, encouragement, and enforcement. For illustration, the Florida programs in Brevard County and Duval County focused on delivering bicycle safety education to children. Marin County California however, went beyond safety education to include infrastructure improvements, promotional/incentive events, and

⁶³ “Implementing” also includes providing funding to existing programs as well as enhancing current programs for more targeted response to the specific objectives of Conserve by Bicycle Program set by the Legislature.

crossing guards.⁶⁴ Planned activities in Florida such as in FDOT District 7, which include bicycle safety education, bicycle rodeos, and school zone flashers construction may provide opportunity for Florida-based before-and-after effectiveness evaluation for the Phase II of this Study.

2. Target children's attitudes towards wearing bicycle helmets. The local Bicycle/Pedestrian Coordinator in Brevard County, FL attributed the lack of an increase in the percentage of students riding bicycles to the bike helmet law (some children chose not to ride instead of having to wear a helmet because they thought that it was not "cool" to wear a helmet).
3. Conduct before-and-after program evaluation within the same school year, so that the effects of program activities on bicycle mode share among the target audience can be observed. Marin County California surveyed students and parents at the beginning and at the end of the same school year. Although Florida's Brevard County's surveys and Duval County's counts provide information on how many students are bicycling to school, the evaluation methodologies used did not lend themselves to measuring change resulting from program activities during the school year.

This Phase I study research has shown that comprehensive Safe Routes to School programs can increase the numbers of children biking to school. The most successful programs included facility improvements, paired with promotional/encouragement events and incentives. Traffic safety education and parental outreach were also common to the successful programs. Data were not yet able to establish which aspects of the successful programs will accomplish the specific objectives of the Conserve by Bike Program. It is recommended that Safe Routes to School programs implementing the various elements mentioned above continue to be sponsored

⁶⁴ It should be noted that Florida is the nationally recognized leader with regards to training crossing guards and creating procedures to address their placement. In Florida, crossing guard training focuses on how to cross children safely across a roadway. Including crossing guards in promotional or informational campaigns is not a typical feature of Safe Routes to School Programs in Florida, nor is it recommended that crossing guards be included in these Safe Routes programs if such inclusion would inhibit their ability to perform their primary function safely.

and that the Phase II study investigate which components are essential to increase bicycling and exercise, thereby countering the current trend towards childhood obesity in Florida.

It is also recommended that the State explore ways to influence the selection of school sites (and configuration of their “sending zones” affected by barriers such as limited access roadways) by local school boards, so that selection criteria include the density of residential development planned in the area near the school and the provision of bicycle facilities (appropriate to the age groups served by the school) connecting the school to the residential areas around it.

Responsible Agencies The Florida Department of Transportation would lead this effort by implementing these recommendations through the Safe Routes to School program.

Implement Education and Marketing Programs to Promote Bicycle Commuting

The Phase I research has shown that education and marketing programs can be effective in increasing levels of bicycle commuting if they include certain elements: a coordinator or other staff person dedicated to the operation of the program; the use of incentives, such as commuting rewards and other forms of recognition for participants; a continuing schedule of events that promote bicycle commuting; and partnerships with employers and other enterprises. It is recommended that both private employers and public agencies fund the implementation of education and marketing programs that include these elements that are essential to achieving the Conserve by Bicycle objectives.

Responsible Agencies The Florida Department of Transportation would lead this effort. The Department of Health would assist in this effort through the provision of statistical information and through its materials distribution network.

Private Employers

The literature shows overwhelmingly that programs implemented by employers can significantly influence commuting by bicycle. These place-of-employment based programs include providing safe and convenient bicycle parking, lockers, showers, events, commuting assistance, and

incentives to those who ride bikes to work. Lockers and showers make it more convenient for employees to ride to work. Events such as Bike to Work Month, safety and health fairs are shown to be excellent times to promote bicycling. Assistance programs for bicycle commuters such as guaranteed ride home programs and commuter coach programs make cycling more appealing to employees. Incentives such as prizes for those who ride a certain number of times a week/month/year or coupons for bike related goods and services, have been included in programs around the United States that have realized significant increases in bicycling.

Responsible Agencies The Florida Department of Transportation would lead this effort. The Department of Health would assist in this effort through the provision of statistical information. Both agencies would meet with employers to provide information and promotional materials to support bicycle commuter encouragement programs.

Government Agencies

The Phase I study evaluations show that governmental agencies can help promote and coordinate efforts by employers to increase bicycling. Through the provision of promotional materials, agencies can help employers begin and promote their own efforts. Agencies can provide staff help to disseminate promotional materials and to track the effectiveness of biking promotions. Agencies themselves are usually large employers and can lead by example and encourage their employees to ride bikes.

To increase benefits and minimize costs, education and marketing programs in Florida should implement the following cross-cutting activities:

- Incorporate a comprehensive range of program activities that appeal to a wide audience. For example, Portland Oregon's TravelSmart and SmartTrips programs provide information about bicycling to residents and employees, conduct group bicycle rides for new and inexperienced riders, and distribute bicycle helmets and lights.
- Undertake an extended marketing effort. For example in Oregon, the City of Portland's on-going marketing program lasts for six months. This extended time period allows each program to reach more of its target audience and affords residents an opportunity to change their travel behavior. For programs aimed at commuters, an extended effort

lasting several months, or possibly having several bike months throughout the year, may sustain bicyclist interest and participation, and thereby result in greater energy savings and health benefits than observing a single Bike to Work month.

- Select areas that already have good bicycling infrastructure to implement encouragement programs. People are more likely to ride bicycles if they perceive that it is safe to do so, as when bicycle lanes, shared use paths adjacent to roadways, or independent alignments are present.
- Dedicate paid and volunteer staff. For example, the 2007 SmartTrips Southeast program has budgeted 4.35 FTE staff and 500 hours of volunteer time.
- Conduct before-and-after program evaluation so that the effects of program activities on the level of bicycling among the target audience can be observed. While bike-to-work programs can potentially have lasting impacts, few such programs conduct follow-up surveys of participants. Evidence from follow-up surveys in two Florida cities, Boca Raton and West Palm Beach, suggests that about 20% to 25% of program participants whose first bicycle commuting experience was during these events are still bicycling three months later.

Responsible Agencies The Florida Department of Transportation would lead this effort.

Working with Department of Health, FDOT would encourage communities to promote public private/partnerships targeted at increasing bicycling.

Study and Implement Education and Marketing Programs that Promote Recreational Bicycling

Just as certain approaches to education and marketing are effective in promoting bicycle commuting, it is hypothesized that there are approaches that are effective in promoting *recreational* bicycling. It is recommended that the Phase II study research investigate the types of programs and approaches that are successful in getting new recreational bicyclists to ride. Such programs could include the designation and promotion (via maps and advertising) of routes suitable for recreational/exercise riding by cyclists of all levels. Other programs to be investigated for effectiveness in the Phase II study would include partnerships with local public

health agencies and other organizations to promote bicycling as an accessible way to meet the CDC's recommendations for moderate physical activity.

Responsible Agencies The Florida Department of Transportation would lead this effort. FDOT, working with the Department of Environmental Protection, Visit Florida, and the Department of Health would prepare promotional materials promoting recreational cycling. Evaluations should be performed to measure the effectiveness of specific promotional campaigns.

Enforcement

While not specifically studied as part of this Conserve by Bicycle Program Study, evidence is plentiful in research, surveys and transportation planning throughout Florida that traffic law enforcement is an important component of improving safety for Florida's bicyclists and thereby changing the perception of many "potential bicyclists." With better motorist and bicyclist behavior, a greater increase in mode shift and recreation/exercise is likely to occur.

While enforcement of all laws is important, enforcement campaigns should focus on those behaviors which are most likely to cause crashes. Specifically, enforcement campaigns should focus on reducing bicycle riding against traffic in the roadway, increasing motorists yielding to bicyclists, improving cyclists' visibility at night, and preventing traffic signal violations.

Law enforcement agencies should be encouraged to give warnings or citations to cyclists who ride on the roadway against the flow of traffic. Riding against traffic in the roadway places cyclists in a location where motorists turning left off the roadway or entering the road from a side street are not likely to scan for traffic (Figure 7-3).

While cyclists are usually allowed to ride on the sidewalk (except in some central business districts), motorists may not look for higher speed (compared to pedestrians) bicycle traffic on the sidewalk. Consequently law enforcement campaigns should also address turning motorists who fail to yield the right of way to bicyclists riding on paths or sidewalks adjacent to the roadways. In addition, pathway users who fail to yield when they are required to by signage should be the subject of enforcement campaigns.

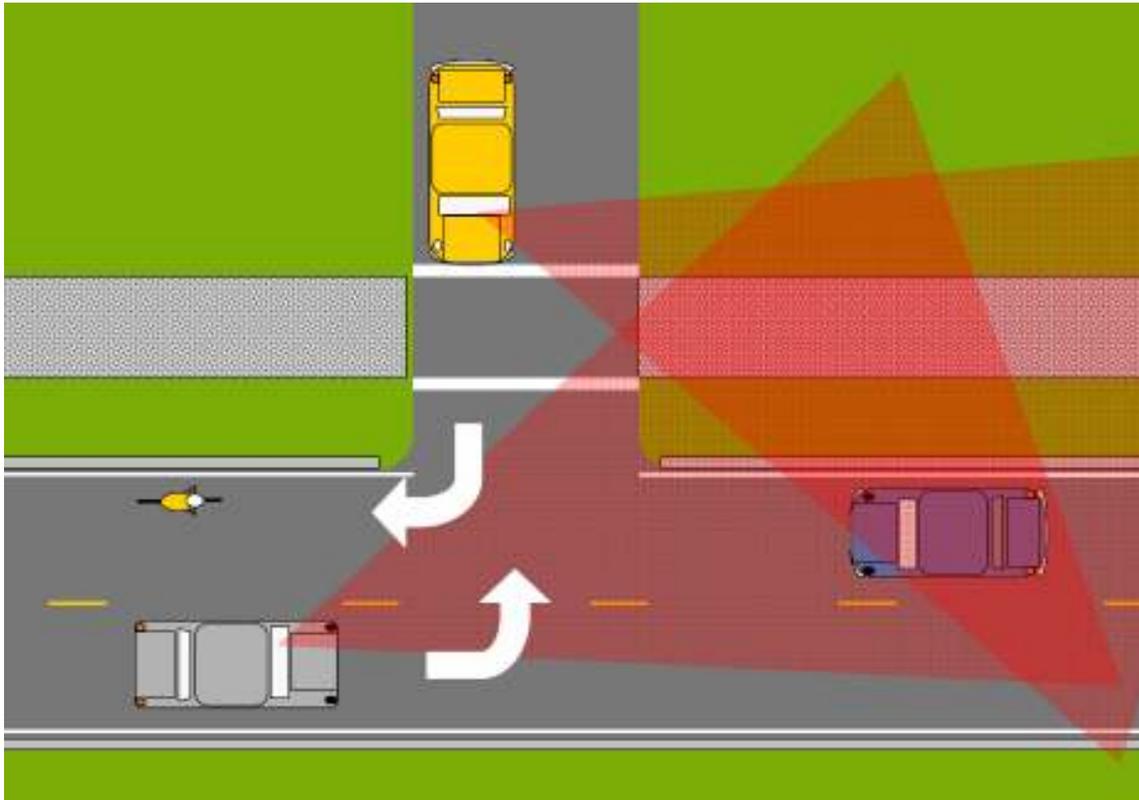


Figure 7-3 Typical motorists' scanning behavior

Enforcement should encourage the use of lights at night by bicyclists. Nighttime crashes are usually the result of cyclists being hit by turning motorists. Reflectors are not effective in preventing this type of crash because the reflector is not in the field of the headlamps until it is too late for the motorists to avoid the bicyclist. Headlamps can prevent many of these crashes.

The running of red lights and stop signs are behaviors that are thought to adversely impact the attitudes of motorists toward bicyclists.⁶⁵ While running stop signs is certainly illegal, it is often done by motorists and bicyclists after yielding to oncoming traffic; it would be inconsistent to heighten enforcement of stop sign running against cyclists without a commensurate increase in motorist enforcement. Red light running is a much more blatant and potentially dangerous behavior, and one for which cyclists are rarely cited. Consistent

⁶⁵ Approximately 95% of the individuals surveyed agreed or strongly agreed that "Police should give warnings or tickets to bicyclists who violate the law." (Berman, Evan. *Bicycling and Walking Attitudes Survey District 5*. University of Central Florida, Orlando, FL, 2003.)

enforcement of the red light running laws against cyclists would likely reduce this behavior and, in turn, result in more positive perceptions of bicyclists. (Prior to beginning a campaign, an enforcement agency should work with the streets department to ensure the signal hardware can detect cyclists and that cyclists are not simply treating a defective signal as a stop sign.)

If these behaviors can be reinforced through a selective enforcement campaign, the potential of motor vehicle-bicycle crashes in Florida will be reduced.

Responsible Agencies The Florida Department of Law Enforcement would lead this effort. Working with the Department of Highway Safety and Motor Vehicles and Department of Transportation, the Department of Law Enforcement could prepare informational and encouragement materials for local law enforcement agencies to present the benefits of enforcing the laws as they relate to bicycle safety. The Department of Highways Safety and Motor Vehicles could work with the Florida Highway Patrol to encourage the enforcement of these laws as well. FDOT and the Safety Office would serve in an advisory and evaluation capacity to help plan specific enforcement methods and campaigns and evaluate the effectiveness of those campaigns.

Phase II – Data Collection and Evaluations

While performing the Conserve by Bicycle Program Study, the researchers identified data needs for the Phase II portion of the Study. It is also realized that bicycle professionals would likely need training in collecting data for, and using, the Health Benefits and Energy Savings worksheet in Appendix M. To meet these data and training needs, it is recommended that the following activities be pursued as part of Phase II of the Conserve by Bicycle Program Study:

Data Needs

- Intercept survey to determine the number of utilitarian trips and number of recreational trips and their trip lengths – These data are needed to help validate assumptions in the Health Benefits and Energy Savings calculations and analysis spreadsheet. An intercept survey yields facility-specific information about bicycle tripmaking, whereas an online survey yields more general information.

- Evaluation of utilitarian and recreational models on facilities after they are built to compare how well they predict trips versus the actual number of trips – Bicycle facilities are programmed on 10 of the 17 corridors included in the Conserve by Bicycle Program Study. The researchers have already used the models to predict what the number of trips would be with various bicycle facility improvements. It is recommended that observations be made of the actual number of bicycle trips after the programmed facilities have been built. By comparing the predicted and actual values, how well the models perform in predicting trips can be assessed; if necessary, adjustments can be made to the models to improve their predictive accuracy.
- Refined model that predicts trip length as a function of speed limit and signals per mile – Accurate prediction of the number of utilitarian bicycle trips depends in part on accurate trip length information. Trip lengths for model development were obtained from intercept surveys. However, intercept surveys require considerable effort for survey distribution and data reduction. With a good trip length model, the number of utilitarian bicycle trips can be predicted without the need for conducting intercept surveys to obtain trip length.
- Before-and-after bicycle counts in school zones – These counts will serve as an indicator of how effective a Safe Routes to Schools program is in encouraging more students to ride bicycles to school. The increase in counts from the “before” to the “after” period will provide a basis for estimating the health benefits and energy savings resulting from additional students riding bicycles to school.
- Changes to school bus routes and schedules – Students who live within walking distance of a school may be bused to school if school administrators determine that conditions are unfavorable for bicycling or walking to school.^{66, 67} With an improvement in bicycling

⁶⁶ Florida Administrative Code 6A-3.001 defines walking distance as:

(3) A reasonable walking distance for any student who is not otherwise eligible for transportation pursuant to Section 1011.68, Florida Statutes, is any distance not more than two (2) miles between the home and school or one and one-half (1 1/2) miles between the home and the assigned bus stop. Such distance shall be measured from the closest pedestrian entry point of the property where the student resides to the closest pedestrian entry point of the assigned school building or to the assigned bus stop. The pedestrian entry

conditions, some students who previously rode the school bus will likely ride bicycles to school, thereby reducing the demand for school bus service.

- Before-and-after vehicle counts at school parent dropoff – If fewer parents are driving their children to school in the “after” period, then the Safe Routes to Schools program has succeeded in motivating at least some students to ride bicycles (or walk) to school.
- The level of replaced activity and the associated energy savings and health benefits – Individuals can choose from among many options for leisure. These include riding a bicycle on a trail, driving to the park, and staying at home and watching rented movies, to name just a few. The presence of a bicycle facility may motivate some individuals to opt for bicycling on the facility instead of pursuing another activity. Replaced activity may or may not result in energy savings. If a person rides a bicycle from his/her home to a trail and then back home, instead of driving to the park, then energy savings will result because the bicycle trip replaces the driving trip. On the other hand, if a person drives to a trail head, rides a bicycle on a trail, and then drives back home, then energy savings may or may not result. Indeed, if the alternate choice was to stay at home and watch movies, then the trail has created a new driving trip.
- Long-term effects of providing bicycle facilities and the associated energy savings and health benefits – In the long term, recreational bicyclists may become utilitarian bicyclists, utilitarian bicyclists may become commuter bicyclists, and occasional bicyclists may become frequent bicyclists.
- Effects of reducing “free” motor vehicle parking and other incentives to driving – A reduction in driving incentives would likely reduce the utility of the car mode and increase the utilities of the bicycle, walk, and transit modes. As a result, the bicycle mode share would likely increase. This increased level of bicycling would be in addition to increased levels attributable to providing bicycle facilities and implementing programs.

point of the residence shall be where private property meets the public right-of-way. The district shall determine the shortest pedestrian route whether or not it is accessible to motor vehicle traffic.

⁶⁷ Florida Statutes 1006.23 describes hazardous walking conditions.

Training Needs

- Expansion of the current multi-modal LOS training offered by FDOT
- Training on how to collect field data needed to determine bicycling conditions and walking conditions
 - Bicycling conditions and walking conditions are both needed for the mode shift model
 - Bicycling conditions are needed for the recreational model
 - Bicycling conditions is an input to the calculation of bicycle network friendliness
 - Walking conditions is an input to the calculation of pedestrian network friendliness
- Training on how to define the network analysis zone
- Guidance on how to select cut lines for intercept surveys and network analysis zones
- Following development of the User spreadsheet, training curriculum on how to use the Health Benefits and Energy Savings calculations and analysis spreadsheet

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